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TRANSACTIONS

OF THE

New England

COTTON MANUFACTURERS' ASSOCIATION.

Founded July 25, 1865. Incorporated Dec. 1, 1894.

No. 51.

SEMI-ANNUAL MEETING.

HELD AT THE PROFILE HOUSE, N. H.

SEPTEMBER 22-24, 1896.

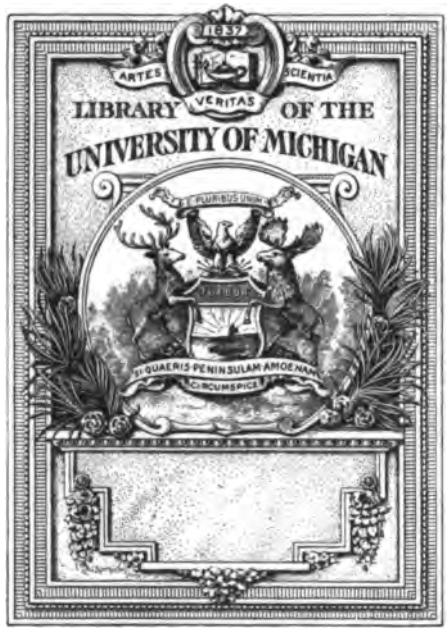
Office of the Association:

501 John Hancock Building, No. 178 Devonshire St., and No. 35 Federal St., Boston, Mass.

WALTHAM, MASS.:

PRESS OF E. L. BARRY.

1896.



THE GIFT OF

Association.

NEW ENGLAND

Cotton Manufacturers' Association.

Proposal for

.....

Membership of

.....

Notice to Members.

To make the Cotton Manufacturers' Association an absolutely representative body must it include as many as possible of those who are eligible for membership. It has been found that many who were eligible and desired to join had not done so because not invited. It is hoped that every member will present the matter to non-members among his associates. The accompanying blank proposition for membership can be detached from the cover at the row of perforations.

ARTES SCIENTIA VERITAS

NEW ENGLAND

Cotton Manufacturers' Association.

Proposal for

.....

Membership of

.....

Application Received

.....189 .

Action by Board of Government, ... *favorable.*

.....189 .

Voted by the Association, ... *elected,*

.....189 .

New England
Cotton Manufacturers' Association.

Founded July 26, 1865. Incorporated December 1, 1884.

ROOM 501 JOHN HANCOCK BUILDING,

No 178 Devonshire Street, and No. 35 Federal Street.

PROPOSAL FOR MEMBERSHIP.

(When filled out, to be mailed to the Secretary, P. O. Box 3672, Boston, Mass., in time for action by the Board of Government, a least one week before a meeting of the Association.)

Mr. .....

Position, ...

P. O. Address, ...

is proposed for ..... *membership in the* NEW ENGLAND COTTON
active or associate

MANUFACTURERS' ASSOCIATION *by* .....
signature of member proposing candidate.

a member of the Association.

Experience of Applicant, (Please state, in full. particulars of detail, giving names, dates, and nature of work, as fully as convenient.)

.....

.....

.....

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The undersigned certifies that the above statements are correct, and agrees that, if elected to the Association, he will be governed by its rules as long as his connection with it shall continue.

Date, ... *189* .

.....
signature of candidate.

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1550
.N2

TRANSACTIONS

OF THE

New England

COTTON MANUFACTURERS' ASSOCIATION,

Founded July 25, 1865. **Incorporated Dec. 1, 1894.**

No. 61.

SEMI-ANNUAL MEETING.

HELD AT THE PROFILE HOUSE, N. H.

SEPTEMBER 22-24, 1896.

Office of the Association:

501 John Hancock Building, No. 178 Devonshire St., and No. 35 Federal St., Boston, Mass.

WALTHAM, MASS.:

PRESS OF E. L. BARRY,

1896.

ENTERED ACCORDING TO ACT OF CONGRESS
IN THE YEAR 1896
BY THE NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION,
IN THE OFFICE OF THE LIBRARIAN OF CONGRESS
AT WASHINGTON.

By vote of the Board of Government, the price of the *Transactions* is $5.00 per copy to non-members, and $1.00 per copy to members for extra copies, in addition to the one to which they are entitled as a part of the privilege of membership.

Copies previous to Volume 61 sold to members at 50 cents each.

CHARTER.

No. 6091.

Commonwealth of Massachusetts.

BE IT KNOWN, That whereas, EDWARD W. THOMAS, C. J. H. WOODBURY, WILLIAM J. KENT, F. M. MESSENGER, HARRY T. WHITIN, ARTHUR H. LOWE, ALBERT F. KNIGHT, ALFRED M. GOODALE, FRED C. MCDUFFIE and GEORGE W. BEAN have associated themselves with the intention of forming a corporation under the name of the NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION, for the purpose of encouraging scientific investigation and experiment as to the methods of manufacturing cotton; collecting and imparting information relating to this industry, promoting social intercourse among its members; and establishing and maintaining a library of works on textiles in the city of Boston, and have complied with the provisions of the Statutes of this Commonwealth in such case made and provided, as appears from the certificate of the President, Treasurer and Directors of said corporation, duly approved by the Commissioner of Corporations, and recorded in this office.

Now, Therefore, I, WILLIAM M. OLIN, Secretary of the Commonwealth of Massachusetts, do hereby certify that said EDWARD W. THOMAS, C. J. H. WOODBURY, WILLIAM J. KENT, F. M. MESSENGER, HARRY T. WHITIN, ARTHUR H. LOWE, ALBERT F. KNIGHT, ALFRED M. GOODALE, FRED C. MCDUFFIE and GEORGE W. BEAN, their associates and successors, are legally organized and established as and are hereby made an existing corporation under the name of the

NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION,

with the powers, rights and privileges, and subject to the limitations, duties and restrictions which by law appertain thereto.

Seal of the Commonwealth of Massachusetts.

Witness my official signature hereunto subscribed, and the seal of the Commonwealth of Massachusetts hereunto affixed this first day of December, in the year of our Lord one thousand eight hundred and ninety-four.

WILLIAM M. OLIN,

Secretary of the Commonwealth.

197061

NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION.

FOUNDED JULY 26, 1865.

INCORPORATED DECEMBER 1, 1894.

CONSTITUTION AND BY-LAWS.

ACTIVE MEMBERS.

ARTICLE 1. Any person who is actively engaged as President, Treasurer, Agent, Superintendent or Manager in the manufacture, printing or finishing of cottons shall be eligible for active membership.

ELECTION OF MEMBERS.

ARTICLE 2. All nominations for membership shall be made in writing, at least one week before the date of any regular meeting, and shall be considered by the Board of Government, and reported to the meeting, favorably or adversely, for the action of the Association. *Provided*, that in case the Board shall decide to report adversely upon any nomination, the member who shall have made it shall be informed of the intention so to report, in order that he may have an opportunity to withdraw the name. Upon such report active members may be admitted, if they obtain a majority of votes of the members present and voting therefor, by acceptance in writing, and paying an admission fee of ten dollars, and maintaining their membership by the payment of an annual assessment not exceeding ten dollars. Any member failing to pay two successive assessments shall cease to be a member at the end of six months from the date when such second assessment shall become due. Any member may withdraw from the Association upon payment of all arrearages, first giving notice of his intention so to do, in writing, to the Secretary, and the Board of Government may accept such resignation; and any member may be expelled for cause,

at any regular meeting, two-thirds of the members present voting therefor.

ASSOCIATE MEMBERS.

ARTICLE 3. Persons engaged in the manufacture of cotton or cotton fabrics, or the manufacture of textile machinery, or industries kindred to the cotton manufacture, may become associate members of the Association. The methods of application, nomination, election and withdrawal from the Association being under the same conditions as those provided for active members in Article 2, excepting that this class of membership does not carry with it the privilege of voting or speaking, except by permission from the Board of Government or a vote of the Association to allow permission.

The initiation fee for associate members shall be twenty-five dollars, and the annual assessment shall be double the sum annually voted for active members.

Associate members may be expelled by a majority vote of the Board of Government.

HONORARY MEMBERS.

ARTICLE 4. Honorary members may be elected, when recommended by the Board of Government, at any regular meeting of the Association, who shall be enrolled as such, and shall be entitled to attend the meetings of the Association and participate in its proceedings, without the right to vote. They shall not be subject to payment of admission fees or assessments. No person actively engaged in cotton manufacture shall be eligible to honorary membership.

ARTICLE 5. It shall be the duty of all members of the Association to make returns to the Secretary of such statistics as may be called for by him, under the direction of any committee duly appointed for the collection of statistics, when not incompatible with private interests.

OFFICERS.

ARTICLE 6. The officers of this Association shall be a President, two Vice-Presidents, six Directors, a Treasurer, Secretary, and Auditor of Accounts.

ELECTION OF OFFICERS.

ARTICLE 7. At each annual meeting there shall be chosen by ballot a President, two Vice-Presidents and two Directors; the President and Vice-Presidents to serve one year, and the two Directors shall be chosen for terms of three years.

DUTIES OF OFFICERS.

ARTICLE 8. The President, or in his absence the senior Vice-President present, shall preside at all meetings of the Association and of the Board of Government. All officers shall hold their respective offices until their successors shall be chosen and accept their positions.

ARTICLE 9. The President, Vice-Presidents and Directors shall constitute a Board of Government, and have under their care and direction all matters pertaining to the management of the Association; and five of their number shall constitute a quorum for the transaction of business. Meetings of the board may be called by the President, at such time and place as he may deem expedient, giving each member a written or printed notice of the same at least five days before the day of meeting. At their first meeting the board shall elect a Treasurer, Secretary, and Auditor of Accounts for the year ensuing, and fix the amount of compensation of the Secretary. All vacancies in their board occasioned by death or resignation shall be filled by the board; and the persons so elected shall hold their offices until the next annual meeting. The board may, from time to time, as they shall deem expedient, appoint committees, from among their own board or from the members at large, to collect statistical information, examine new inventions or processes in manufacturing goods, as also to prepare essays on subjects of interest to the Association.

ARTICLE 10. The Treasurer shall keep a book in which all receipts and payments of money shall be entered, collect all moneys due the Association, and disburse the same upon the written order of the Board of Government. At the annual meeting in each year he shall make an exhibit of his accounts, or oftener if the Board of Government require it. He shall notify the members of assessments voted, and cause them to be collected in a reasonable time.

ARTICLE 11. The Secretary shall attend all meetings of the Association and of the Board of Government, and keep accurate records of

their doings. In the absence of the Secretary at any meeting, a Secretary *pro tem.* may be appointed by the presiding officer, who shall be sworn to do all things, while in office, required of the Secretary.

ARTICLE 12. The Auditor shall examine the accounts of the Treasurer annually, and report at each meeting the state of the finances.

MEETINGS.

ARTICLE 13. The annual meeting of the members of the Association shall be held on the last Wednesday of April, or at such other time, and at such hour and place as the Board of Government may appoint. There shall also be a semi-annual meeting of the Association on the last Wednesday of October, in each and every year, or at such other time, and at such place and hour as the Board of Government may appoint.

Special meetings may be called by the Board of Government whenever they deem it expedient, or upon the written application of any ten members, made to the Secretary.

ARTICLE 14. All meetings of the members of the Association shall be in pursuance of a written or printed notice, addressed to each member, with the name of the President or Secretary attached thereto, and deposited in the Post Office ten days at least before the day of meeting, specifying the time and place of meeting; and at all such meetings fifteen members shall constitute a quorum for the transaction of business.

ARTICLE 15. Amendments to the By-Laws may be made at any stated meeting of the Association by a two-thirds vote; *provided*, notice of such proposed amendment be given in writing at a previous meeting, and also notice be given to each member by the Secretary, of the pendency of such amendment, ten days at least before any such meeting.

BOARD OF GOVERNMENT.

1896.

PRESIDENT.

ARTHUR H. LOWE, ... FITCHBURG, MASS.

VICE-PRESIDENTS.

WILLIAM J. KENT, ... NEW BEDFORD, MASS.
FRED. C. McDUFFIE, ... BOSTON, MASS.

DIRECTORS.

ALBERT F. KNIGHT, ... ADAMS, MASS.
HENRY T. WHITIN, ... NORTHBRIDGE, MASS.
HERBERT L. PRATT, ... LEWISTON, ME.
STEPHEN A. KNIGHT, ... PROVIDENCE, R. I.
JOHN ECCLES, ... TAFTVILLE, CONN.
RUSSELL W. EATON, ... BRUNSWICK, ME.

AUDITOR.

J. H. SAWYER, ... BOSTON, MASS.

SECRETARY.

C. J. H. WOODBURY, P. O. BOX 3672, BOSTON, MASS.

OFFICERS OF THE ASSOCIATION.

FROM THE FIRST ORGANIZATION.

PRESIDENTS.

Ezekiel A. Straw,	1865–78	Henry F. Lippitt,	1888–89
Amos D. Lockwood,	1878–80	Walter E. Parker,	1889–92
John Kilburn,	1880–83	Robert McArthur,	1892–94
William C. Lovering,	1883–85	Edw. W. Thomas,	1894–95
Richard Garsed,	1885–86	A. M. Goodale,	1895-96.
J. S. Ludlam,	1886–88	ARTHUR H. LOWE,	1896.

VICE-PRESIDENTS.

Amos D. Lockwood,	1865–77	Walter E. Parker,	1885–89
William A. Burke,	1865–73	Richard B. Borden,	1886–88
John C. Palfrey,	1873–76	Arnold B. Sanford,	1888–91
Edward Atkinson,	1876–78	Robert McArthur,	1889–92
A. G. Cumnock,	1877–80	Simeon B. Chase,	1891–93
Charles Nourse,	1878–81	E. W. Thomas,	1892–94
William F. Goulding,	1880–83	A. M. Goodale,	1893-95
Richard Garsed,	1881–85	WILLIAM J. KENT,	1894
J. S. Ludlam,	1883–86	FRED. C. McDUFFIE,	1895

DIRECTORS.

J. S. Davis,	1865–69	A. M. Wade,	1868–69
Charles Nourse,	1865–78	D. J. Johnston,	1869–70
Phineas Adams,	1865–74	A. G. Cumnock,	1869–77
William P. Haines,	1865–69	F. E. Clarke,	1869–75
Thomas J. Borden,	1865–78	John Kilburn,	1870–80
Daniel D. Crombie,	1865–68	William P. Haines,	1874–78

DIRECTORS.—Concluded.

Cyrus I. Barker,	1875–80	Robert McArthur,	1886–89
Hervey Kent,	1877–81	S. S. Spencer,	1887–90
David J. Johnston,	1878–82	E. W. Thomas,	1888–92
Walter Paine, 3d,	1878–80	William W. Whitin,	1888–93
Chas. L. Lovering,	1878–83	Robert R. Smith,	1889–92
Richard Garsed,	1880–81	Alfred M. Goodale,	1890–93
William H. Jennings,	1880–83	William J. Kent,	1891–94
Chas. D. McDuffie,	1881–83	Herman F. Straw,	1891–93
Walter E. Parker,	1881–85	Fred C. McDuffie,	1892–95
John W. Danielson,	1881–85	George W. Bean,	1892–95
William E. Barrows,	1882–83	F. M. Messenger,	1893–95
Rufus A. Maxfield,	1883–86	Arthur H. Lowe,	1894-96
George W. Weeks,	1883–86	ALBERT F. KNIGHT,	1893
Henry S. Howe,	1883–87	HENRY T. WHITIN,	1894
Richard B. Borden,	1883–86	JOHN ECCLES,	1895
O. S. Brown,	1885–91	HERBERT L. PRATT,	1895
Henry F. Lippitt,	1885–88	STEPHEN A. KNIGHT,	1895
Wilbur A. Stiles,	1886–88	RUSSELL W. EATON,	1895
Stephen N. Bourne,	1886–91		

AUDITORS.

Benjamin Saunders,	1865–71	Henry D. Sullivan,	1873–82
John C. Palfrey,	1871–73	JACOB H. SAWYER,	1882

SECRETARY AND TREASURER.

Ambrose Eastman,	1865–94	C. J. H. WOODBURY,	1894

MEMBERS OF THE ASSOCIATION.

Oct. 1, 1896.

Members of the Association are respectfully requested to scrutinize the following list, and advise the Secretary, P. O. Box 3672, Boston, Mass., of change in address, of any error in regard to their names; also to inform him of the decease of fellow members residing in their vicinity.

HONORARY MEMBERS.

GEORGE ARMS	Grand Hotel	New York City	Oct. 16, 1872.
AMBROSE EASTMAN	53 State St.	Boston, Mass.	Sept. 27, 1894.

ACTIVE MEMBERS.

Stephen I. Abbott	Agt. Lockwood Co.	Waterville, Me.	Apr. 21, 1869.
Alfred E. Adams	Supt. Whitinsville Cotton Mills	Whitinsville, Mass.	Apr. 27, 1887.
John S. Adams, Jr.	Supt. Adams Bros. Mfg. Co.	Adams, Mass.	Apr. 29, 1896.
Stephen L. Adams	Treas. Stafford Mfg. Co.	Central Falls, R. I.	Apr. 24, 1895.
Joseph D. Aiken	Ponemah Mills	Taftville, Conn.	Oct. 28, 1891.
F. S. Akin	Supt. Cornell Mills	Fall River, Mass.	Sept. 27, 1894.
Charles T. Aldrich	Treas. Aldrich Mfg. Co.	Box 34, Providence, R. I.	Apr. 28, 1886.
George E. Ames	Mech. Supt. Lawrence Mfg. Co.	Lowell, Mass.	Apr. 24, 1895.
William Ames	Treas. Fletcher Manufg. Co.	Box 83, Providence, R. I.	Apr. 30, 1879.
Charles B. Amory	Treas. Hamilton Manufg. Co.	70 Kilby St., Boston, Mass.	Apr. 25, 1894.
John W. Arrington	Treas. & Agt. Edna Cotton Mills	Reidsville, N. C.	Oct. 25, 1895.
Abel T. Atherton		Bayside, Warwick, R. I.	Oct. 16, 1872.
Edward Atkinson	Prest. Boston Mfrs. Mu. Fire Ins. Co.	Boston, Mass.	Apr. 19, 1871.
Edward W. Atkinson	Stoddard, Haserick, Richards Co.	152 Congress St., Boston, Mass.	Oct. 27, 1886.
H. C. Atwood	Treas. Williamsville Manufg. Co.	Killingly, Conn.	Apr. 29, 1885.
James A. Atwood	Agt. Wauregan Mills	Wauregan, Conn.	Oct. 28, 1891.
John Walter Atwood	Supt. Wauregan Mills	Wauregan, Conn.	Oct. 25, 1895.
W. E. Atwood	Secy. and Asst. Treas. Williamsville Manufg. Co.	Killingly, Conn.	Sept. 27, 1894.
Geo. A. Ayer	Supt. City Manufg. Corporation	New Bedford, Mass.	Apr. 24, 1895.

Charles L. Bailey	Gen. Supt. Boston Manufg. Co.	Waltham, Mass.	Sept. 27, 1894.
Henry A. Bailey	Agt. Chicopee Manufg. Co.	Chicopee Falls, Mass.	Oct. 25, 1893.
Edwin H. Baker	Bliss, Fabyan & Co.	Box 2899, New York	Apr. 24, 1878.
Philip S. Baker	Treas. Crowders Mountain Cotton Mills,	Kings Mt., N. C.	Oct. 25, 1895.
Edward R. Ballou	Supt. Brighton Mills	541 West 23rd St., N. Y.	Apr. 25, 1894.
William P. Bancroft	V. P. Joseph Bancroft & Sons Co.	Wilmington, Del.	Oct. 31, 1883.
A. D. Barker	Agt. Avon Manufg. Co.	Lewiston, Me.	Apr. 19, 1871.
Lewis E. Barnes	Supt. Methuen Co.	Methuen, Mass.	Oct. 25, 1895.
William A. Barrell	Agt. Lawrence Duck Co.	Lawrence, Mass.	Apr. 30, 1884.
Edwin N. Bartlett	Supt. Sigourney and Rockdale Mills,	North Oxford, Mass.	Apr. 29, 1891.
Joseph P. Battles		Box 1460, Boston, Mass.	Oct. 25, 1895.
George W. Bean	Agt. Androscoggin Mills	Lewiston, Me.	Apr. 17, 1872.
Truman Beckwith	Treas. Dyerville Manufg. Co.	Box 171, Prov., R. I.	Apr. 17, 1892.
W. N. Blackstone	Treas. Attawaugan Co.	Norwich, Conn.	Apr. 29, 1896.
William W. Blades	Supt. Crefeld Mills	Westerly, R. I.	Oct. 25, 1893.
Nathaniel B. Borden	Treas. Barnard Manufg. Co.	Fall River, Mass.	Oct. 15, 1873.
Richard B. Borden	Treas. Richard Borden Mfg. Co. Treas. Troy C. & W. Mfg. Co.	Fall River, Mass.	July 26, 1865.
Thomas J. Borden	Pres. Richard Borden Manufg. Co.	Box 118, Fall River, Mass.	July 26, 1865.
E. S. Boss	Agt. Willimantic Linen Co.	Willimantic, Conn.	Oct. 29, 1879.
Stephen N. Bourne	Agt. Stark Mills	Manchester, N. H.	Oct. 21, 1868.
Arthur F. Brackett	Supt. Riverpoint and Arctic Mills	Riverpoint, R. I.	Oct. 25, 1895.
Ernest Bridge	Supt. Jas. Chadwick & Bro. Ltd.	Jersey City, N. J.	Apr. 24, 1895.
James W. Brown	Agt. Warren Cotton Mills	West Warren, Mass.	Oct. 25, 1895.
O. S. Brown	Agt. Salmon Falls Manufg. Co.	Salmon Falls, N. H.	Apr. 21, 1875.
E. C. Bucklin	Treas. Interlaken Mills, Treas. Harris Mfg. Co.	Box 289, Providence, R. I.	Apr. 25, 1883.
Robert Burgess	Supt. Pierce Mfg. Corp.	New Bedford, Mass.	Apr. 27, 1892.
Edward N. Burke	Lowell Machine Shop	Lowell, Mass.	Apr. 29, 1880.
W. R. Burnham	Treas. Uncasville Manufg. Co.	Norwich, Conn.	Apr. 29, 1885.
William D. Cadwell	Agt. Nashua and Jackson Companies	Nashua, N. H.	Apr. 19, 1871.
John P. Campbell	Supt. N. Y. Mills	Oneida Co., N. Y.	Sept. 22, 1896.
Byron F. Card	Agt. New Bedford Manufg. Co.	New Bedford, Mass.	Apr. 25, 1888.
Arnold B. Chace, Jr.	Agt. Woonsocket Mills	Valley Falls, R. I.	Apr. 24, 1895.
George A. Chace	Treas. Bourne Mills	Fall River, Mass.	Apr. 25, 1877.
H. S. Chadwick	Pres. Dover Yarn Mill Pres. Dilling Cotton Mills	Charlotte, N. C.	Apr. 24, 1895.
Simeon B. Chase	Treas. King Philip Mills	Fall River, Mass.	Apr. 21, 1875.
Clarence N. Childs	Asst. Supt. Hamilton Manufg. Co.	Lowell, Mass.	Apr. 24, 1895.
Elmer G. Childs	Agt. Boston Duck Co.	Bondsville, Mass.	Oct. 26, 1892.
Alfred Clarke	Eastern Electric Light and Storage Battery Co.	Lowell, Mass.	Apr. 30, 1879.
Ernest E. Clark	Supt. Sutton Manufg. Co.	Wilkinsonville, Mass.	Apr. 29, 1896.
Fred E. Clarke	Agt. Pemberton Co. Agt. Methuen Co.	Lawrence, Mass.	July 26, 1865.

George A. Clark	Supt. Manchester Mills	Manchester, N. H.	Oct. 25, 1882.
Jeremiah Clark	Textile Machinery . 277 Dutton St.	Lowell, Mass.	Oct. 15, 1873.
J. William Clark	Clark Thread Co.	Newark, N. J.	Oct. 26, 1892.
W. H. Cloher, Jr.	Agt. Utica Cotton Co.	Capron, Oneida Co., N. Y.	Sept. 22, 1896.
Alonzo A. Coburn	Whitehead Machine Co.	Lowell, Mass.	Apr. 25, 1888.
Josiah G. Coburn		Newton, Mass.	July 26, 1865.
John A. Collins	Supt. American Linen Co. 73 Cottage St.	Fall River, Mass.	Oct. 31, 1883.
Frank B. Comins	Vice-Pres. and Gen. Mgr. Aerphor Co. P. O. Box 1555,	Providence, R. I.	Oct. 28, 1891.
John J. Connell	Supt. Cohannet Mills	Taunton, Mass.	Apr. 27, 1892.
Alphonse S. Covel	Treas. Tremont and Suffolk Mills P. O. Box 1716,	Boston, Mass.	Oct. 31, 1877.
P. T. Creed	Supt. Hopewell Mills	Taunton, Mass.	Sept. 22, 1896.
A. G. Cumnock	Agt. Boott Cotton Mills	Lowell, Mass.	Oct. 28, 1885.
Andrew J. Currier	Valley Falls Co.	Albion, R. I.	Apr. 25, 1888.
T. B. Dallas	Treas. Phœnix Cotton Mills Treas. Dallas Manufg. Co.	Nashville, Tenn. Huntsville, Ala.	Oct. 25, 1895.
Woodbury K. Dana	Treas. Dana Warp Mills	Westbrook, Me.	Apr. 25, 1888.
Albert W. Danforth	Supt. & Chief Engineer Shanghai Cot. Cloth Co., China 881 Bridge St.	Shanghai, Lowell, Mass.	Apr. 27, 1881.
A. Lockwood Danielson	Asst. Treas. Quinebaug Co. Box 900,	Providence, R. I.	Sept. 27, 1894.
J. DeForest Danielson	Asst. Treas. Lockwood Co.	Providence, R. I.	Sept. 27, 1894.
John W. Danielson	Treas. Lockwood Co. Box 900,	Providence, R. I.	July 15, 1868.
B. D. Davol	P. O. Box 418	Fall River, Mass.	Apr. 25, 1877.
James C. Deane	Supt. Griswoldville Manufg. Co.	Griswoldville, Mass.	Apr. 25, 1894.
William P. Dempsey	Agt. Dempsey Bleachery and Dye Works,	Pawtucket, R. I.	Apr. 28, 1886.
Charles W. Dennett	Agt. Johnson Manufg. Co. Agt. Dunbar Mills Co.	North Adams, Mass.	Oct. 29, 1890.
Edward P. Dennis	Lowell Machine Shop	Lowell, Mass.	Apr. 25, 1888.
Charles A. Denny	Gen. Mgr. Amer. Card Clothing Co.	Leicester, Mass.	Apr. 25, 1888.
P. Y. DeNormandie	Supt. Potomska Mills	New Bedford, Mass.	Apr. 29, 1896.
Chas. Owen Dexter	Mgr. Canadian Col'd Cot Mills, Ltd.	Hamilton, Ont.	Apr. 24, 1895.
George Dexter	Treas. Pepperell and Laconia Cos. 30 Kilby St.	Boston, Mass.	Oct. 31, 1877.
F. Dilling	Sec'y & Treas. Dilling Cotton Mills	Kings Mountain, N. C.	Oct. 25, 1895.
Chas. C. Diman	Treas. Whitman Mills	New Bedford, Mass.	Apr. 24, 1895.
Albert W. Dimick	Atlantic Cotton Mills	Lawrence, Mass.	Apr. 25, 1894.
Eben S. Draper	Geo. Draper & Sons	Hopedale, Mass.	Oct. 31, 1888.
George A. Draper	Geo. Draper & Sons	Hopedale, Mass.	Oct. 31, 1888.
George Otis Draper	Geo. Draper & Sons	Hopedale, Mass.	Apr. 24, 1895.
William F. Draper	Geo. Draper & Sons	Hopedale, Mass.	Jan. 17, 1867.
William F. Draper, Jr.	Geo. Draper & Sons	Hopedale, Mass.	Oct. 29, 1890.
John Drowne	Supt. Cocheco Mfg. Co.	Dover, N. H.	Apr. 29, 1896.
Joseph M. Dunham	Supt. Merrick Thread Co. 190 Walnut St.	Holyoke, Mass.	Oct. 26, 1892.

David H. Dyer	Mill Engineer 7 and 8 Pocassett Bank Building	Fall River, Mass.	Oct. 18, 1871.
William A. Eastman	Supt. Lowell Hosiery Co.	Lowell, Mass.	Sept. 27, 1894.
Russell W. Eaton	Agt. Cabot Manufg. Co.	Brunswick, Me.	Oct. 26, 1887.
John Eccles	Supt. Ponemah Mills	Taftville, Conn.	Apr. 27, 1892.
D. M. Ehrlich	Treas. Galveston Cotton Mills	Galveston, Texas.	Apr. 24, 1895.
Lawrence V. Elder		Dickinson, Texas	Oct. 27, 1886.
Frederick W. Ely	Agt. Columbian Manufg. Co.	Greenville, N. H.	Apr. 25, 1888.
H. B. Estes	Agt. Continental Mills	Lewiston, Me.	Apr. 26, 1893.
William Evans	Supt. Richard Borden Mfg. Co.	Fall River, Mass.	Apr. 29, 1896.
C. E. Falls	Sec. and Treas. Enterprise Mills	Kings Mountain, N. C.	Oct. 25, 1895.
Herbert R. Farnum	Supt. Bernon Mills	Georgiaville, R. I.	Apr. 27, 1881.
Clifton L. Field	Treas. Massaemit Yarn Mills	Shattuckville, Mass.	Apr. 25, 1894.
Frank S. Field	Supt. Massaemit Yarn Mills	Shattuckville, Mass.	Oct. 25, 1895.
William Firth	Mgr. Am. Drosophore Co. 150 Devonshire St.,	Boston, Mass.	Apr. 25, 1888.
Charles H. Fish	Agt. Cocheco Manufg. Co.	Dover, N. H.	Apr. 27, 1887.
Henry E. Fisher	Agt. Atlanta Cotton Mills	Atlanta, Ga.	Oct. 25, 1895.
Herbert Fisher		Taunton, Mass.	Oct. 29, 1879.
William B. Fittz	Supt. West Boylston Manufg. Co.	Oakdale, Mass.	Oct. 26, 1892.
Frederick A. Flather	Mech. Eng. Lowell Machine Shop	Lowell, Mass.	Apr. 29, 1891.
M. F. Foster		Milford, N. H.	Apr. 17, 1872.
Philip H. Fowler		Gloucester City, N. J.	Nov. 30, 1881.
Edward W. France	Dir. of Philadelphia Textile Schools,	Philadelphia, Pa.	Sept. 22, 1896.
C. H. Frisbie	Agt. Attawaugan Co.	Norwich, Conn.	Oct. 29, 1890.
William Gammell	Agt. Berkeley Co.	Providence, R. I.	Oct. 28, 1885.
James G. Garland		Biddeford, Me.	Oct. 29, 1879.
Richard Garsed	Wingohocking Mills, Frankford Sta.	Philadelphia, Pa.	Apr. 17, 1872.
James S. Gary	Pres. Gary Manufg. Co.	Baltimore, Md.	Apr. 25, 1883.
John Gegenheimer		Old Orchard, Me.	Apr. 30, 1890.
Charles E. Getchell	Supt. Waltham Bleachery and Dye Works	Waltham, Mass.	Oct. 30, 1889.
Daniel Gilligan	Supt. Pocasset and Metacomet Mills	Fall River, Mass.	Apr. 29, 1896.
William C. Godfrey	Agt. Indian Orchard Mills	Indian Orchard, Mass.	Oct. 29, 1890.
Alfred M. Goodale	Treas. Boston Manufg. Co. 50 State St.,	Boston, Mass.	Apr. 25, 1883.
Charles J. Goodwin	Indian Orchard Mills	Indian Orchard, Mass.	Oct. 18, 1871.
Charles H. Gorton	Supt. Ballou Mills	Woonsocket, R. I.	Apr. 25, 1894.
Marcellus Gould	Agt. Falls Company	Norwich, Conn.	Sept. 22, 1896.
William B. Gowdey	Mill Supplies 40 Clifford St. Box 707,	Providence, R. I.	Apr. 30, 1890.
George P. Grant, Jr.	Treas. Grant Yarn Co.	Fitchburg, Mass.	Sept. 27, 1894.
D. W. Gray	Supt. Skenandoa Cotton Co.	Utica, N. Y.	Oct. 26, 1892.
R. A. Gray	Supt. Rodman Manufg. Co.	Allenton, R. I.	Apr. 24, 1895.
Stephen Greene	Mill Engineer and Architect 131 Devonshire St.,	Boston, Mass.	Oct. 27, 1886.

William C. Greene	Gen. Mgr. Peace Dale Manufg. Co.	Peace Dale, R. I.	Oct. 27, 1886.
Joseph Warren Greene	Supt. Hamilton Web. Co.	Wickford, R. I.	Apr. 29, 1896.
John Gregson	Supt. Merchants Manufg. Co.	Fall River, Mass.	Apr 24, 1895.
Frederick Grinnell	Pres. Gen. Fire Extinguisher Co.	Providence, R. I.	Apr. 24, 1878.
Arthur H. Gulliver	Asst. Supt. Lonsdale Co.	Ashton, R. I.	Apr. 24, 1889.
B. F. Guy	Supt. Pelzer Manufg. Co.	Pelzer, S. C.	Apr. 24, 1895.
Frank R. Hadley	Treas. Bennett Manufg. Co.	New Bedford, Mass.	Oct. 28, 1891.
Frank J. Hale	Agt. Pettee Machine Works	Newton Upper Falls, Mass.	Apr. 27, 1892.
Samuel Hale	Vice-Pres. and Gen. Manager Dixie Cotton Mills	La Grange, Ga.	Oct. 29, 1890.
William E. Hall	Supt. Boston Duck Co.	Bondsville, Mass.	Apr. 27, 1892.
Z. D. Hall	Gen. Supt. B. B. & R. Knights Mills	Providence, R. I.	Oct. 29, 1879.
John H. Hambly	Treas. Quidnick Manufg. Co.	Providence, R. I.	Apr. 24, 1895.
John F. Hamlet	P. O. Box 160,	Fall River, Mass.	Oct. 31, 1888.
John O. Hannum	Agt. Saratoga Victory Manufg. Co.	Victory Mills, Saratoga Co., N. Y.	Apr. 30, 1890.
Frank Harris	Hamlet Mills	Woonsocket, R. I.	Apr. 24, 1889.
Henry F. Harris	Treas. West Boylston Manufg. Co.	Box 282, Worcester, Mass.	Apr. 30, 1890.
John J. Hart	Supt. Merrimack Print Works	Lowell, Mass.	Apr. 24, 1895.
A. M. Hathaway	Supt. H. N. Slater Mills	Webster, Mass.	Sept. 27, 1894.
Samuel E. Hathaway	Supt. Fall River Iron Works	Fall River, Mass.	Sept. 27, 1894.
William Hathaway	Supt. Barnard Manufg. Co.	Fall River, Mass.	Apr. 25, 1894.
William B. Hawes	Treas. No. Dighton Cotton Co.	Fall River, Mass.	Oct. 25, 1895.
Alfred Hawkesworth	Supt. Merchants Manufg. Co.	Montreal, P. Q.	Apr. 26, 1893.
Fred Hawkesworth	Asst. Supt. Merchants Manufg. Co.	Montreal, P. Q.	Sept. 22, 1896.
Horace L. Hayden	Agt. Walhalla Cotton Mills	Walhalla, S, C.	Apr. 24, 1895.
William Hayes	Agt. Barker Mill	Auburn, Me.	Apr. 30, 1879.
W. G. Henderson	Agt. Shetucket Co.	Norwich, Conn.	Apr. 29, 1896.
James G. Hill	Supt. Lawrence Manufg. Co.	Lowell, Mass.	Jan. 15, 1868.
William R. Hill	Treas. Glasgow Manufg. Co.	South Hadley Falls, Mass.	Oct. 25, 1893.
Geo. H. Hills	Treas. Davol Mills & Stephens Mfg. Co.	Fall River. Mass.	Oct. 25, 1875.
John H. Hines	Agt. Queen City Cotton Co.	Burlington, Vt.	Sept. 27, 1894.
Charles H. Hobbs	Agt. Thorndlke Co.	Thorndike, Mass.	Apr. 28, 1886.
John Holland		Dover, N. H.	Oct. 31, 1877.
Gideon F. Holmes	Treas. and Gen. Mgr. Plymouth Cordage Co.	No. Plymouth, Mass.	Oct. 30, 1889.
George W. Holt	Agt. Monohansett Manufg. Co.	Putnam, Conn.	Oct. 29, 1879.
William P. Holt	Supt. Slatersville Mills	Box 315, Slatersville, R. I.	Oct. 25, 1893.
George L. Hooper	Mangr. Shaw Stocking Co.	Lowell, Mass.	Apr. 25, 1892.
Jno. Hopkinson	Gen. Mgr. Slayden & Kirksey Woolen Mills	Waco, Texas	Apr. 25, 1883.
Henry S. Houghton, Jr.	Supt. Paul Whitin Manufg. Co.	Northbridge, Mass.	Apr. 24, 1895.
Elisha H. Howard	Agt. Harris Manufg. Co.	Providence, R. I.	Apr. 25, 1883.
Henry S. Howe	Lawrence & Co.	68 Chauncey St., Boston, Mass.	Oct. 31, 1877.

W. S. Hume	Supt. Pequot Mills	Montville, Conn.	Oct. 29, 1890.
Arthur W. Hunking	Agt. Mass. Mills, in Georgia	Lindale, Floyd County, Ga.	Apr. 24, 1895.
J. E. Jenckes	Treas. E. Jenckes Co.	Pawtucket, R. I.	Apr. 24, 1895.
David L. Jewell	Agt. China. Webster & Pembroke M.	Suncook, N. H.	July 26, 1865.
David S. Johnston	Cohoes Foundry & Machine Co.	Cohoes, N. Y.	Oct. 28, 1891.
W. T. Jordan	Mgr. Mountain Island Mfg. Co.	Mountain Island, N. C.	Oct. 25, 1895.
Frank E. Kaley	Treas. Morse & Kaley Mfg. Co.	Milford, N. H.	Oct. 25, 1895.
W. E. Keach	Supt. E. Jenckes Mfg. Co.	57 Harrison St., Pawtucket, R. I.	Oct. 26, 1892.
Roland R. Kelly	Supt. Williamstown Manufg. Co.	Williamstown Sta., Mass.	Nov. 30, 1881.
Joseph H. Kendrick	Agt. American Supply Co.	Box 850, Providence, R. I.	Apr. 30, 1879.
George E. Kent	Agt. Pittsfield Mills / Mgr. Exeter Mills	Pittsfield, N. H.	Oct. 31, 1888.
Hervey Kent	Ex-Treas. Exeter Manufg. Co.	Exeter, N. H.	July 26, 1865.
William J. Kent	Agt. Wamsutta Mills	New Bedford, Mass.	Oct. 26, 1887.
Nathaniel B. Kerr	Agt. Grinnell Manufg. Corp.	New Bedford, Mass.	Oct. 26, 1892.
John Kilburn		Belmont, Mass.	July 26, 1865.
Harry W. Kimball	Supt. Jewett City Mills	Jewett City, Conn.	Oct. 25, 1895.
John M. Kimball	Agt. Slatersville Mills / Special Atty. Jewett City Mills	4 Market Sq., Prov., R. I.	Oct. 31, 1888.
Albert Knight	Supt. Quidnick Mills	Anthony, R. I.	Apr. 25, 1895.
Albert F. Knight	Agt. Berkshire Cotton Manufg. Co.	P. O. Box 963, Adams, Mass.	Oct. 27, 1886.
Jesse A. Knight	Supt. Harris Manufg. Co.	Phenix, R. I.	Oct. 26, 1892.
Stephen A. Knight	Agt. Hebron Manufg. Co.	Box 820, Providence, R. I.	Oct. 21, 1868.
Walter B. Knight	Reynolds Manufg. Co.	Davisville, R. I.	Apr. 24, 1889.
Fred C. Lacey	Supt. Montreal Cotton Co.	Valleyfield, P. Q.	Apr. 24, 1895.
Walter H. Langshaw	Supt. Dartmouth Manufg. Corp.	New Bedford, Mass.	Apr. 29, 1896.
Elliott Cowdin Lambert	Supt. Amoskeag Manufg. Co.	Manchester, N. H.	Oct. 25, 1895.
Abbott F. Lawrence	Treas. Nemasket Mills	Box 125, Taunton, Mass.	Apr. 24, 1895.
Harold Lawton	Gen. Mgr. Warwick Mills	Centreville, R. I.	Oct. 27, 1886.
Evan Arthur Leigh	Textile Machinery	70 Kilby St., Boston, Mass.	Oct. 29, 1890.
J. Colby Lewis	Supt. Centreville Cotton Mills	Centreville, R. I.	Oct. 26, 1892.
Charles W. Lippitt	Treas. Silver Spring B. & D. Co.	Providence, R. I.	Oct. 30, 1878.
Henry F. Lippitt	Agt. Social and Manville Cos.	Providence, R. I.	Apr. 27, 1881.
Robert W. Lord	Agt. R. W. Lord & Co.	Kennebunk, Me.	Oct. 20, 1869.
Ernest Lovering	Agt. Lyman Mills	Holyoke, Mass.	Apr. 25, 1888.
Henry M. Lovering	Agt. Whittenton Manufg. Co.	Taunton, Mass.	Oct. 27, 1880.
William M. Lovering	Supt. Whittenton Manufg. Co.	Taunton, Mass.	Sept. 27, 1894.
Arthur H. Lowe	Treas. Parkhill Manufg. Co.	Fitchburg, Mass.	Oct. 30, 1889.
David Lowe	Asst. Supt. Parkhill Manufg. Co.	Fitchburg, Mass.	Apr. 24, 1895.
Dudley T. Lyall	Asst. Mgr. Brighton Mills	541 W. 23d St., N. Y.	Sept. 23, 1896.
William L. Lyall	Supt. J. & W. Lyall Loom and Machine Works	541 W. 23d St., New York City	Oct. 26, 1892.

Herbert Lyman	Treas. Hadley Co.	95 Milk St., Boston, Mass.	Oct. 25, 1895.
Otis G. Lynch	Supt. Enterprise Manufg. Co.	Augusta, Ga.	Oct. 25, 1895.
Alvin S. Lyon	Supt. Lowell Manufg. Co.	Lowell, Mass.	Apr. 26, 1882.
Jas. R. MacColl	Agt. Lorraine Manufg. Co.	Pawtucket, R. I.	Apr. 24, 1895.
Chas. L. Macomber	Agt. Nemasket Mills	Taunton, Mass.	Apr. 24, 1895.
Charles T. Main	Mech. and Mill Engineer	Exchange Bldg., Boston, Mass.	Oct. 28, 1885.
Charles R. Makepeace	Mill Engineer	Box 973, Providence, R. I.	Apr. 30, 1890.
Arthur B. Mann	Box 465	99 Franklin St., New York	Apr. 25, 1894.
Charles H. Manning	Gen. Supt. Amoskeag Manufg. Co.	Manchester, N. H.	Oct. 28, 1885.
Henry F. Mansfield	Gen. Supt. Utica Steam Cotton Mills and Mohawk Valley Cotton Mills	Utica, N. Y.	Apr. 30, 1890.
Albert G. Martin	Supt. Kincaid Manufg. Co.	Box 272, Griffin, Ga.	Apr. 30, 1884.
Ira J. Martin	Supt. Bozrahville Co.	Bozrahville, Conn.	Oct. 26, 1892.
Philip A. Mathewson	Supt. Chace Mills	Box 607, Fall River, Mass.	Apr. 24, 1895.
Rufus A. Maxfield		Lowell, Mass.	Apr. 17, 1872.
Thomas Mayor	Textile Machinery	26 Olney St., Providence, R. I.	Oct. 27, 1880.
Robert McArthur	Agt. Pepperell and Laconia Cos.	Biddeford, Me.	Apr. 17, 1872.
Charles D. McDuffie	Agt. Manchester Mills	Manchester, N. H.	Apr. 21, 1869.
Fred C. McDuffie	Treas. Everett Mills and York Manufg. Co.	Box 2963 Boston, Mass.	Oct. 25, 1892.
William G. McLoon	Supt. Boston Manufg. Co.	Waltham, Mass.	Apr. 27, 1892.
James H. McMullan	Agt. Saco Water Power Machine Co.	Biddeford, Me.	Apr. 21, 1869.
William P. McMullan	Agt. Naumkeag Steam Cotton Co.	Salem, Mass.	Sept. 27, 1894.
John Tempest Meats	Supt. Mason Machine Works	Taunton, Mass.	Apr. 27, 1887.
Charles H. Merriman, Jr.	Asst. Supt. Social Nourse Mills	Woonsocket, R. I.	Apr. 25, 1895.
Frank M. Messenger	Agt. Grosvenor Dale Co.	No. Grosvenor Dale, Conn.	Apr. 27, 1887.
W. H. Miles	Agt. Farwell Mills	Lisbon, Me.	Sept. 22, 1896.
James I. Milliken	Agt. Everett Mills	Lawrence, Mass.	Oct. 26, 1892.
Roscoe S. Milliken	Supt. Pemberton Co.	Lawrence, Mass.	Apr. 29, 1896.
A. B. Mole	Mgr. Greylock Mill	Adams, Mass.	Apr. 24, 1895.
Edward A. Mongeon	Supt. Blackstone Manufg. Co.	Blackstone, Mass.	Apr. 24, 1895.
Fred W. Moore	Agt. Cordis Mills	Millbury, Mass.	Apr. 27, 1892.
George F. Morgan	Lowell Machine Shop	Lowell, Mass.	Oct. 28, 1891.
Albert H. Morton	Supt. Kitson Machine Co.	Lowell, Mass.	Oct. 28, 1891.
Fred S. Mosher	Supt. Henrietta Mills	Henrietta, Rutherford Co., N. C.	Oct. 25, 1895.
Oliver H. Moulton	Supt. Hamilton Manufg. Co.	Lowell, Mass.	July 26, 1865.
Farquharson J. Muir	Supt. Canadian Col. Cot. Mills Co.	Hamilton, Ont., Can.	Apr. 27, 1892.
Wm. B. Munroe	Supt. Millville Manufg. Co.	Millville, N. J.	Oct. 25, 1895.
Roscius C. Newell	Supt. Palmer Mill	Three Rivers, Mass.	Oct. 25, 1895.
William G. Nichols	Supt. Lancaster Mills	Clinton, Mass.	Oct. 25, 1893.
Franklin Nourse	Agt. Lawrence Manufg. Co.	Lowell, Mass.	Apr. 24, 1878
Eben H. Nutting	Agt. Hooksett Mills	Hooksett, N. H.	Oct. 25, 1882.

S. Odenheimer	Lane Mills	New Orleans, La.	Oct. 25, 1893.
Charles K. Oliver	Treas. Columbia Mills Co.	Columbia, S. C.	Sept. 27, 1894.
Warren M. Orswell	Pres. Orswell Mills, Nockedge Mills and Lancaster Manufg. Co.	Fitchburg, Mass.	Apr. 16, 1873.
Oscar L. Owen	Mech. and Mill Eng. Whitin Machine Works	Whitinsville, Mass.	Apr. 25, 1894.
Elmer E. Page	Agt. York Manufg. Co.	Saco, Me.	Apr. 27, 1892.
Francis J. Parker	Treas. Monadnock Mills, 27 Kilby St.,	Boston, Mass.	Jan. 15, 1868.
O. B. Parker	Supt. U. S. Cotton Co.	Central Falls, R. I.	Apr. 24, 1895.
Samuel L. Parker	Supt. Turners Falls Cotton Mills Box 267,	Turners Falls, Mass.	Apr. 29, 1896.
Walker E. Parker	Agt. Pacific Mills	Lawrence, Mass.	Apr. 25, 1877.
John H. Parks	Pres. Wm. Parks & Son, Ltd.	St. John, N. B.	Apr. 24, 1878.
Duncan D. Parmly	Treas. JohnsonMfg. Co. and Dunbar Mills Co. 160 Broadway,	New York, N. Y.	Sept. 22, 1896.
John W. Pead	Agt. Merrimack Manufg. Co. Box 1231,	Lowell, Mass.	Apr. 26, 1893.
James R. Pearce	Supt. Fulton Bag and Cotton Mills 68 So. Boulevard,	Atlanta, Ga.	Oct. 25, 1895.
Wm. C. Peirce	Pres. Elizabeth Mills, 564 Eddy St.,	Providence, R. I.	Apr. 24, 1895.
William D. Pennell	Agt. Hill Manufg. Co.	Lewiston, Me.	Apr. 16, 1873.
Haven C. Perham	Treas. Kitson Machine Co.	Lowell, Mass.	Apr. 30, 1879.
Henry C. Phillips	Supt. H. N. Slater Mills	Webster, Mass.	Apr. 25, 1894.
Andrew G. Pierce, Jr.	Treas. Pierce Manufg. Corp.	New Bedford, Mass.	Apr. 24, 1895.
Reuben Pilling, Jr.	Supt. Granite Mills Co.	Greenville, R. I.	Apr. 29, 1896.
Moses Pierce	Pres. Aspinook Co.	Norwich, Conn.	Oct. 30, 1878.
Charles H. Plummer	Agt. Great Falls Manufg. Co.	Somersworth, N. H.	Apr. 25, 1888.
Thomas C. Powell		Providence, R. I.	Oct. 30, 1889.
Herbert L. Pratt	Agt. Bates Manufg. Co.	Lewiston, Me.	Oct. 27, 1885.
T. W. Pratt	Pres. and Sec'y West Huntsville Cotton Mills Co.	Huntsville, Ala.	Sept. 22, 1896.
John E. Prest	Gen. Supt. Harmony Mills	Cohoes, N. Y.	Apr. 17, 1872.
M. W. Quinn	Agt. Hamilton Woolen Co.	Amesbury, Mass.	Oct. 27, 1886.
T. G. Ramsdell	Agt. Monument Mills	Housatonic, Mass.	Oct. 30, 1878.
M. A. Rawlinson	Supt. Tremont and Suffolk Mills	Lowell, Mass.	Apr. 24, 1895.
Robert Redford	Agt. Arlington Mills	Lawrence, Mass.	Apr. 26, 1882.
James Renfrew	Treas. Renfrew Manufg. Co.	Adams, Mass.	Oct. 18, 1871.
Roscoe C. Reynolds	Agt. Lewiston Machine Co.	Lewiston, Me.	Oct. 25, 1876.
F. H. Rice	Holbrook Mills Box 47,	W. Boylston, Mass.	Apr. 29, 1880.
Charles H. Richardson	Agt. Appleton Co.	Lowell, Mass.	Apr. 24, 1889.
C. W. Rider	Treas. Merrick Thread Co.	Holyoke, Mass.	Apr. 29, 1896.
Charles E. Riley	Textile Machinery Box 2815 281 Congress St.,	Boston, Mass.	Apr. 25, 1888.
Charles D. Robinson	Supt. Crompton Co.	Crompton, R. I.	Sept. 27, 1894.

William A. Robinson	Treas. Savannah Cotton Mills	Savannah, Ga.	Apr. 29, 1896.
John K. Russell	Gen. Mgr. May's Landing Water P. Co. and Millville Manufg. Co.	Millville, N. J.	Apr. 30, 1884.
Arnold B. Sanford	Pres. Sanford Spinning Co.	Fall River, Mass.	Oct. 25, 1882.
Charles Henry Savage	Supt. Manville Co.	Manville, R. I.	Apr. 26, 1893.
J. H. Sawyer	Treas. Newmarket Manufg. Co. Box 2966,	Boston, Mass.	July 26, 1865.
George H. Sayward	Mgr. Standard Yarn Co.	Oswego, N. Y.	Oct. 29, 1890.
Arnold Schaer	Supt. Warren Manufg. Co.	Warren, R. I.	Apr. 24, 1895.
John Scott	Supt. Willimantic Linen Co.	Willimantic, Conn.	Oct. 29, 1879.
George H. Shapley	Mgr. Silver Lake Co. 78 Chauncy St.,	Boston, Mass.	Apr. 29, 1896.
Frank P. Sheldon	Mill Engineer	Providence, R. I.	Apr. 25, 1894.
Thomas C. Sheldon	Agt. Fitchburg Duck Mills	Fitchburg, Mass.	Oct. 29, 1884.
Willis S. Shepard	Pres. American Net and Twine Co. 34 Commercial St.,	Boston, Mass.	Apr. 29, 1896.
George E. Sherman		Central Falls, R. I.	Apr. 27, 1881.
William F. Sherman	Agt. Atlantic Cotton Mills	Lawrence, Mass.	Apr. 15, 1874.
Charles M. Shove	Treas. Granite Mills Box 45,	Fall River, Mass.	Oct. 27, 1875.
Herbert H Shumway	Treas. Corr Manufg. Co.	Taunton, Mass.	Apr. 24, 1895.
Francis H. Silsbee	Supt. Cotton Dept. Pacific Mills	Lawrence, Mass.	Apr. 27, 1887.
Louis Simpson	Gen. Mgr. Montreal Cotton Co.	Valleyfield, P. Q.	Apr. 24, 1895.
Abbott E. Slade	Treas. Laurel Lake Mills	Fall River, Mass.	Oct. 25, 1893.
Arba C. Slater	Supt. Linwood Mills	Whitinsville, Mass.	Jan. 15, 1868.
Arthur T. Smith	Supt. Langley Manufg Co.	Langley, S. C.	Oct. 25, 1895.
Joel Smith	Supt. The J. P. King Manufg. Co.	Augusta, Ga.	Oct. 25, 1895.
	Supt. Aiken Manufg. Co.	Bath, S. C.	
Robert R. Smith	Mgr. Greenwoods Co.	New Hartford, Conn.	Oct. 19, 1870.
Ellison A. Smyth	Pres. Pelzer Manufg. Co.	Pelzer, S. C.	Oct. 26, 1892.
Wm. S. Southworth	Agt. Mass. Cotton Mills	Lowell, Mass.	Oct. 31, 1888.
William T. Spear	Supt. Jackson Co.	Nashua, N. H.	Oct. 30, 1889.
S. S. Spencer	Supt. Conestoga Steam Mills	Lancaster, Pa.	Oct. 25, 1876.
George E. Spofford	Asst. Supt. Natick Mill	Natick, R. I.	Apr. 29, 1896.
Leroy Springs	Pres. Lancaster Cotton Mills	Lancaster, S. C.	Oct. 25, 1895.
George R. Stearns	Pres. Riverside Mills	Augusta, Ga.	Apr. 30, 1890.
Walter F. Stiles	Treas. Nockedge & Orswell Mills	Fitchburg, Mass.	Oct. 25, 1895.
O. W. Stites	Supt. No. Pownal Manufg. Co.	No. Pownal, Vt.	Oct. 25, 1895.
Joseph Stone	Room 949, 53 State St.,	Boston, Mass.	Oct. 21, 1874.
Herman F. Straw	Agt. Amoskeag Manufg. Co.	Manchester, N. H.	Oct. 28, 1885.
Walter H. Summersby	Supt. Pontiac Mill and Bleachery	Pontiac, R. I.	Oct. 25, 1893.
Albert A. Sweet	Supt. King Philip Mills 969 Charles St.,	Fall River, Mass.	Apr. 24, 1895.
James O. Sweet	Agt. and Treas. Ashland Cotton Co.	Jewett City, Conn.	Apr. 28, 1886.
Edward P. Taft	Treas. Ponemah Mills Box 1443,	Providence, R. I.	Oct. 28, 1885.
Robert Rennie Taft	Supt. Baltic Power Co.	Baltic, Conn.	Apr. 24, 1895.

Robert W. Taft	Asst. Treas. Bernon Mills / Treas. Coventry Co.	Box 1144, Providence, R. I.	Sept. 27, 1894.
George P. Taylor	Agt. Lancaster Mills	Clinton, Mass.	Apr. 25, 1877.
James W. Taylor	Supt. Canoe River Mills	Box 46, Taunton, Mass.	Oct. 26, 1892.
W. Marshall Taylor	Supt. Clark Thread Co.	69 Mechanic St., Westerly, R. I.	Sept. 22, 1896.
Richard Thackeray	Supt. Weetamoe Mills	Fall River, Mass.	Apr. 29, 1885.
Earl A. Thissell	Amasa Pratt & Co.	Lowell, Mass.	Oct. 30, 1878.
Ariel C. Thomas	Supt. Clinton Manufg. Co.	Woonsocket, R. I.	Oct. 31, 1888.
Charles E. Thomas	Treas. Forestdale Manufg. Co.	Woonsocket, R. I.	Oct. 31, 1883.
Edward W. Thomas	Agt. Tremont and Suffolk Mills	Lowell, Mass.	Apr. 30, 1884.
Ralph E. Thompson	Supt. Parkhill Manufg. Co.	Fitchburg, Mass.	Apr. 25, 1894.
D. M. Thompson	Pres. & Treas. Corliss Steam Engine Co.	Providence, R. I.	Oct. 28, 1885.
Osmon B. Tilton	Agt. Dwight Manufg. Co.	Alabama City, Ala.	Oct. 27, 1886.
James P. Tolman	Pres. Samson Cordage Works	115 Congress St., Boston, Mass.	Oct. 29, 1890.
D. A. Tompkins	Pres. Atherton Mills	Charlotte, N. C.	Oct. 25, 1895.
George W. Towne	Supt. Cotton Dept. Arlington Mills	Lawrence, Mass.	Oct. 26, 1892.
William E. Trainer	Pres. Linwood Mills	Trainer, Penn.	Apr. 21, 1875.
Robert B. Treat	Centerville Cotton Mills	Centerville, R. I.	Sept. 27, 1894.
C. H. Truesdell	Supt. Attawaugan Co.	Dayville, Conn.	Apr. 29, 1896.
Edmund E. Truesdell	Supt. China, Webs'r & Pemb'ke Mills	Suncook, N. H.	Apr. 26, 1876.
Oscar B. Truesdell	Agt. Fiskdale Mills	Fiskdale, Mass.	Apr. 24, 1895.
George E. Tucker	Agt. Otis Co.	Ware, Mass.	Oct. 25, 1895.
William D. Twiss	Supt. Everett Mills	Lawrence, Mass.	April 29, 1896.
George A. Vaughan	Supt. Putnam Manufg. Co.	Putnam, Conn.	Sept. 22, 1896.
Frank P. Vogl	Agt. Monadnock Mills	Claremont, N. H.	Sept. 27, 1894.
Jude C. Wadleigh	Supt. Mass. Cotton Mills	Lowell, Mass.	Oct. 26, 1892.
Herbert E. Walmesley	Supt. Clark Thread Co.	Newark, N. J.	Oct. 29, 1890.
James A. Walsh	Agt. Lewiston Bleachery and Dye Works	Lewiston, Me.	Apr. 27, 1892.
James Waring	Treas. Narragansett Mills	1567 No. Main St., Fall River, Mass.	Oct. 27, 1875.
Arthur W. Warren	Treas. W. Warren Thread Works	Westfield, Mass.	Apr. 29, 1896.
John Waterman	Treas. Warren Manufg. Co.	Warren, R. I.	Apr. 30, 1884.
Joseph W. Wattles	Manufacturers' Supplies	Canton Junction, Mass.	July 26, 1865.
T. B. Wattles	Mangr. Boscawen Mills	Penacook, N. H.	July 26, 1865.
George W. Weeks		Clinton, Mass.	Apr. 21, 1869.
W. B. Smith Whaley	Mill Engineer	Columbia, S. C.	Apr. 24, 1895.
H. D. Wheat	Treas. Gaffney Manufg. Co. and Tucapau Mills	Gaffney, S. C.	Apr. 24, 1895.
Channing Whitaker	Questions of Infringement and Patent-ability, Lowell Machine Shop	Lowell, Mass.	Oct. 15, 1873.
A. Tenny White	Supt. Globe Mill	Woonsocket, R. I.	Oct. 26, 1887.

Arthur F. Whitin	Pres. Saunders Cotton Mills Agt. Whitinsville Cotton Mills	Whitinsville, Mass.	Apr. 24, 1895.
Henry T. Whitin	Treas Paul Whitin Manufg. Co.	Northbridge, Mass.	Apr. 25, 1877.
Alfred N. Whiting	Treas. L. M. Harris Manufg. Co.	Oakdale, Mass.	Apr. 21, 1875.
William S. Whitney	Supt. Mech. Dept., Wash. Mills Co.	Lawrence, Mass.	Apr. 24, 1878.
William Whittam, Jr.	Clark Mile End Spool Cotton Co. 319 Summer Ave.,	Newark, N. J.	Apr. 26, 1893.
George F. Whitten	Agt. Amory Mfg. Co.	Manchester, N. H.	Oct. 26, 1892.
Edward B. Wilbur	Supt. Newberry Cotton Mills	Newberry, S. C.	Oct. 30, 1889.
Henry M. Wilcox	Treas. John Rhodes Warp Co.	Millbury, Mass.	Apr. 24, 1889.
Eben C. Willey	Supt. Manchaug Company	Manchaug, Mass.	Apr. 29, 1896.
Theop. W. Wilmarth	Supt. Millbury Cotton Mills	Millbury, Mass.	Oct. 31, 1883.
Thomas Wilmarth	Supt. Saunders Cotton Mills	Saundersville, Mass.	Apr. 21, 1875.
J. P. Wilson	Treas. Dover Cotton Mills	Pineville, N. C.	Oct. 25, 1895.
A. S. Winslow	Agt. Peabody Mills	Newburyport, Mass.	Oct. 31, 1888.
George Wood	Pres. and Treas. Millville Manufg. Co. 626 Chestnut St.,	Phila., Pa.	Oct. 16, 1872.
C. J. H. Woodbury	Secy. and Treas.	Lynn, Mass.	Oct. 29, 1879.
Alvin Woodman	32 Wilder St.	Brockton, Mass.	Apr. 26, 1893.
A. A. Young, Jr.	Treas. Jewett City Mills	Jewett City, Conn.	Sept. 27, 1894.
Adelbert R. Young	Supt. Ashland Cotton Co.	Jewett City, Conn.	Apr. 25, 1894.

ASSOCIATE MEMBERS.

Geo. R. Babbitt	Pres. American Oil Co. 182 So. Water St.,	Providence, R. I.	Apr. 24, 1895.
D. C. Ball	Ball-Warren Commission Co. 109 Walnut St.,	St. Louis, Mo.	Oct. 25, 1895.
Geo. S. Barnum	Secy. and Treas. The Bigelow Co.	New Haven, Conn.	Apr. 24, 1895.
Colin C. Bell	Pres. and Treas. Laminar Fibre Co.	No. Cambridge, Mass.	Apr. 29, 1896.
Frank P. Bennett	Pub. Amer. Wool and Cot. Reporter 148 Pearl St.,	Boston, Mass.	Sept. 22, 1896.
Geo. W. Benson	Dealer in Cotton Waste. A. Emerson & Co. 36 Purchase St.,	Boston, Mass.	Apr. 24, 1895.
William H. Bent	Treas. Mason Machine Works	Taunton, Mass.	Apr. 29, 1896.
W. T. Bessonette	Sec. Temple Gin and Compress Co., and Inventor of Cylindrical Ball and Roller Compress,	Temple, Texas.	Apr. 29, 1896.
J. Payson Bradley	The Kehew-Bradley Co. 24 Purchase St.,	Boston, Mass.	Apr. 24, 1895.
Henry G. Brinckerhoff	N. E. Mgr. Fuel Economizer Co. 53 State St.,	Boston, Mass.	Sept. 22, 1896.
D. Russell Brown	Pres. Brown Bros. Co.	Providence, R. I.	Apr. 24, 1895.
H. Martin Brown	Brown Bros. Co.	Providence, R. I.	Apr. 24, 1895.
John H. Burghardt	Mill Supplies 31 Pearl St.,	Boston, Mass.	Apr. 24, 1895.
Eugene E. Burnham	Leather Belt Mfr. 168 Broadway,	Lawrence, Mass.	Oct. 25, 1895.
James Butterworth	Pres. H. W. Butterworth & Sons Co. York and Cedar Sts.,	Philadelphia, Pa.	Apr. 24, 1895.

Malcolm Campbell	Woonsocket Machine and Press Co.	Woonsocket, R. I.	Apr. 24, 1895.
W. W. Carey	Wood Machinery Builder	Lowell, Mass.	Apr. 24, 1895.
Fred A. Chase	Mill Supplies, F. A. Chase & Co.	Providence, R. I.	Apr. 24, 1895.
Chas. H. Child	Treas. Brown Bros. Co.	Box 890, Providence, R. I.	Apr. 24, 1895.
Peter H. Corr	Cotton and Cotton Yarns	Taunton, Mass.	Apr. 24, 1895.
Thos. G. Cox	Selling Agt. Mason Mach. Works	Box 316, Taunton, Mass.	Apr. 24, 1895.
Frederick I. Dana	Mech. Eng. Thomas Phillips Co.	Providence, R. I.	Apr. 25, 1895.
J. F. Dickinson	Treas. South Belting Co.	Atlanta, Ga.	Apr. 29, 1896.
R. H. Deming	Cotton Merchant	10 So. Water St., Providence, R. I.	Apr. 24, 1895.
C. E. W. Dow	Agt. Metallic Drawing Roll Co.	Indian Orchard, Mass.	Apr. 24, 1895.
G. B. Emmons	Pres. Emmons Loom Harness Co.	Box 203, Lawrence, Mass.	Oct. 25, 1895.
T. C. Entwistle	Cotton Machinery Manufacturer	Lowell, Mass.	Apr. 24, 1895.
D. D. Felton	Treas. S. A. Felton & Sons Co.	Manchester, N. H.	Apr. 24, 1895.
John W. Ferguson	Mill Engineer and Builder	Paterson, N. J.	Apr. 24, 1895.
J. Herbert Foster	Cotton Broker	Providence, R. I.	Apr. 24, 1895.
John R. Freeman	Pres. Mfrs. Mutual Fire Ins. Co.	Providence, R. I.	Sept. 22, 1896.
Geo. A. Fuller	Mgr. Amer. Card Clothing Co.	Providence, R. I.	Apr. 24, 1895.
H. P. Garland	Treas. Loom Picker Co.	Biddeford, Me.	Oct. 25, 1895.
Royal W. Gates	Josiah Gates & Sons, Belting	137 Market St., Lowell, Mass.	Apr. 24, 1895.
W. S. Granger	Prest. Granger Foundry & Machine Co.,	Providence, R. I.	Apr. 24, 1895.
William L. Haines	Agt. for Brooks & Doxey, of Manchester, Eng.	161 Pearl St., Boston, Mass.	Apr. 29, 1896.
A. Walter Harris	Treas. A. W. Harris Oil Co.	326 So. Water St., Providence, R. I.	Oct. 25, 1895.
John H. Haworth	Haworth & Watson Mfrs. Paper Tubes for Textile Manufg.	Lowell, Mass.	Oct. 25, 1895.
Jerome Hill	Pres. Jerome Hill Cotton Co.	116 South Main St., St. Louis, Mo.	Apr. 29, 1896.
Henry A. Holcomb	Treas. New Bedford Boiler Co.	New Bedford, Mass.	Oct. 25, 1895.
C. H. Hutchins	Pres. and Treas. Knowles Loom Works,	Worcester, Mass.	Oct. 25, 1895.
David Jackson	Pres. & Mgr. Jackson Pat. Shell Roll Co.	Pawtucket, R. I.	Apr. 25, 1895.
Wm. B. Kehew	The Kehew-Bradley Co.	24 Purchase St., Boston, Mass.	Apr. 24, 1895.
Josiah M. Lasell	Asst. Treas. Whitin Machine Works,	Whitinsville, Mass.	Apr. 24, 1895.
Stephen C. Lowe	Mill Supplies	New Bedford, Mass.	Oct. 25, 1895.
F. H. Maynard	Bus. Mgr. Gen. Fire Extinguisher Co.,	Providence, R. I.	Apr. 24, 1895.
H. G. McKerrow	Textile Machinery	31 State St., Boston, Mass.	Sept. 22, 1896.

Geo. H. Meader . . . Steam Appliances . . . . 35 Oliver St., Boston, Mass. . Apr. 24, 1895.
Geo. B. Morison . . . Selling Agt. Hadley Co. 95 Milk St., Boston, Mass. . . . Apr. 24, 1895.

Sidney B. Paine . . . Electrical Engineer . . 180 Summer St., Boston, Mass. . Apr. 24, 1895.
Geo. C. Phillips . . . . Treas. Thomas. Phillips Co. . . . . Providence, R. I. . . Apr. 24, 1895.
Stephen Minot Pitman . Sec'y Narragansett Fire Ins. Co., Box 315, Providence, R. I. Apr. 25, 1895.

Charles F. Randall . . Expert in Textiles . . . . . Equitable Bld., Boston, Mass. Apr. 25, 1895.
Richard H. Rice . . . Treas. Rice & Sargent Steam Eng. Co. . . . . 40 Codding St., Providence, R. I. . . Apr. 24, 1895.
C. E. Roberts . . . . Mangr. Hartford St. Boiler Imp. & Inspection Co. . . . . 125 Milk St., Boston, Mass. . Apr. 24, 1895.
John M. Russell . . . Cashier Knowles Loom Works . . . Worcester, Mass. . . Oct. 25, 1895.

E. A. Smith . . . . . Pres. Charlotte Supply Co. . . . . Charlotte, N. C. . . . Oct. 25, 1895.
R. P. Snelling . . . . Treas. Pettee Machine Works . Newton Upper Falls, Mass. Sept. 22, 1896.
Lewis R. Speare . . . Alden Speare Sons & Co., Oil and Mill Supplies . . . . . 369 Atlantic Ave., Boston, Mass. . Oct. 25, 1895.
Henry C. Spence . . . Gen. Mgr. Metallic Drawing Roll Co. Indian Orchard, Mass. Apr. 24, 1895.
Geo. W. Stafford . . . Mgr. Knowles Loom Works . . . . Providence, R. I. . . Apr. 25, 1895.
Daniel J. Sully . . . . Cotton Broker . . . . . Providence, R. I. . . Apr. 24, 1895.

Cyrus A. Taft . . . . Whitin Machine Works . . . . . Whitinsville, Mass. . Apr. 24, 1895.
Winthrop Thayer . . . . . 1015 Tremont Bldg., Boston, Mass. . . . Apr. 29, 1896.
A. Curtis Tingley . . . Treas. Nat. Ring Traveler Co. . . . Providence, R. I. . . Sept. 22, 1896.
Wm. V. Threlfall . . . Selling Agt. Pettee Machine Works . . . . . Newton Upper Falls, Mass. . Apr. 24, 1895.

Frank H. Underwood . Mgr. Dodge Mfg. Co., 137 Purchase St., Boston, Mass. . . Apr. 29, 1896.

Justin A. Ware . . . . Secy. and Treas. Crompton Loom Wks. Worcester, Mass. . . Oct. 25, 1895.
Walter S. Watson . . . Haworth & Watson Mfrs. Paper Tubes . . . . . for Textile Manufg. . . . . Lowell, Mass. . . . Oct. 25, 1895.
Wm. R. West . . . . Roll Coverer . . 830 Purchase St., New Bedford, Mass. . Sept. 22, 1896.
G. Marston Whitin . . Treas. Whitin Machine Works . . . Whitinsville, Mass. . Apr. 24, 1895.
Erving Y. Woolley . . Stoddard, Haserick, Richards & Co. . . . . 152 Congress St., Boston, Mass. . . Apr. 24, 1895.

Honorary Members	2
Active Members	385
Associate Members	72
Total Membership	459

MEMBERS OF THE ASSOCIATION,

Oct. 1, 1896.

ARRANGED BY STATES.

MAINE.

Auburn	William Hayes	Barker Mill.
Biddeford	James G. Garland	
Biddeford	H. P. Garland	Loom Picker Co.
Biddeford	Robert McArthur	Pepperell & Laconia Cos.
Biddeford	Jas. H. McMullan	Saco Water Power Machine Co.
Brunswick	Russell W. Eaton	Cabot Manufg. Co.
Kennebunk	Robert W. Lord	R. W. Lord & Co.
Lewiston	A. D. Barker	Avon Manufg. Co.
Lewiston	George W. Bean	Androscoggin Mills.
Lewiston	H. B. Estes	Continental Mills.
Lewiston	William D. Pennell	Hill Manufg. Co.
Lewiston	Herbert L. Pratt	Bates Manufg. Co.
Lewiston	Roscoe C. Reynolds	Lewiston Machine Co.
Lewiston	James A. Walsh	Lewiston Bleachery and Dye Works.
Lisbon	W. H. Miles	Farwell Mills.
Old Orchard	John Gegenheimer	
Saco	Elmer E. Page	York Manufg. Co.
Waterville	Stephen I. Abbott	Lockwood Co.
Westbrook	Woodbury K. Dana	Dana Warp Mills.

NEW HAMPSHIRE.

Claremont	Frank P. Vogl	Monadnock Mills.
Dover	John Drowne	Cocheco Manufg. Co.
Dover	Charles H. Fish	Cocheco Manufg. Co.
Dover	John Holland	

Exeter	Hervey Kent	Exeter Manufg. Co.
Greenville	Frederick W. Ely	Columbian Manufg. Co.
Hooksett	Eben H. Nutting	Hooksett Mills.
Manchester	Stephen N. Bourne	Stark Mills.
Manchester	George A. Clark	Manchester Mills.
Manchester	D. D. Felton	S. A. Felton & Sons Co.
Manchester	Elliott Cowdin Lambert	Amoskeag Manufg. Co.
Manchester	Charles H. Manning	Amoskeag Manufg. Co.
Manchester	Charles D. McDuffie	Manchester Mills.
Manchester	Herman F. Straw	Amoskeag Manufg. Co.
Manchester	George F. Whitten	Amory Manufg. Co.
Milford	M. F. Foster	
Milford	Frank E. Kaley	Morse & Kaley Manufg. Co.
Nashua	William D. Cadwell	Nashua and Jackson Cos.
Nashua	William T. Spear	Jackson Co.
Penacook	T. B. Wattles	Boscawen Mills.
Pittsfield	George E. Kent	Pittsfield and Exeter Mills.
Salmon Falls	O. S. Brown	Salmon Falls Manufg. Co.
Somersworth	Charles H. Plummer	Great Falls Manufg. Co.
Suncook	David L. Jewell	China, Webster & Pembroke Mills.
Suncook	Edmund E. Truesdell	China, Webster & Pembroke Mills.

VERMONT.

Burlington	John H. Hines	Queen City Cotton Co.
No. Pownal	O. W. Stites	No. Pownal Manufg. Co.

MASSACHUSETTS.

Adams	John S. Adams, Jr.	Adams Bros. Manufg. Co.
Adams	Albert F. Knight	Berkshire Cotton Mfg. Co., Box 963.
Adams	A. B. Mole	Greylock Mills.
Adams	James Renfrew	Renfrew Manufg. Co.
Amesbury	M. W. Quinn	Hamilton Woolen Co.
Belmont	John Kilburn	
Blackstone	Edward A. Mongeon	Blackstone Manufg. Co.
Bondsville	Elmer G. Childs	Boston Duck Co.
Bondsville	Wm. E. Hall	Boston Duck Co.
Boston	Charles B. Amory	Hamilton Manufg. Co.
Boston	Edward Atkinson	Boston Mfrs. Mut. Fire Ins. Co.
Boston	Edward W. Atkinson	Stoddard, Haserick, Richards & Co., 150 Congress St.
Boston	Joseph P. Battles	Box 1460.
Boston	Frank P. Bennett	148 Pearl St.
Boston	Geo. W. Benson	Dealer in Cotton Waste, A. Emerson & Co., 36 Purchase St.

Boston	J. Payson Bradley	The Kehew-Bradley Co., 24 Purchase St.
Boston	Henry G. Brinckerhoff	53 State St.
Boston	John H. Burkhardt	Mill Supplies, 31 Pearl St.
Boston	Alphonse S. Covel	Tremont & Suffolk Mills, Box 1716.
Boston	George Dexter	Pepperell & Laconia Cos.
Boston	Ambrose Eastman	53 State St.
Boston	William Firth	American Drosophore Co., 150 Devonshire St.
Boston	Alfred M. Goodale	Boston Manufg. Co., 50 State St.
Boston	Stephen Greene	Mill Engineer, 131 Devonshire St.
Boston	William L. Haines	Brooks & Doxey, Manchester, Eng., 161 Pearl St.
Boston	Henry S. Howe	Lawrence & Co., 68 Chauncy St.
Boston	William B. Kehew	The Kehew-Bradley Co., 24 Purchase St.
Boston	Evan Arthur Leigh	Textile Machinery, 70 Kilby St.
Boston	Herbert Lyman	Hadley Co., 95 Milk St.
Boston	Charles T. Main	Mech. Mill Engineer, Exchange Bldg.
Boston	Fred C. McDuffie	Everett Mills & York Manufg. Co., Box 2963.
Boston	H. G. McKerrow	Textile Machinery, 35 Oliver St.
Boston	George H. Meader	Steam Appliances.
Boston	George B. Morison	Hadley Co., 95 Milk St.
Boston	Sidney B. Paine	General Electric Co., 180 Summer St.
Boston	Francis J. Parker	Monadnock Mills, 27 Kilby St.
Boston	Charles F. Randall	Expert in Textiles, Equitable Bld.
Boston	Charles E. Riley	Textile Machinery, Box 2815.
Boston	C. E. Roberts	Hartford St. Boiler Imp. & Insp. Co.
Boston	J. H. Sawyer	Newmarket Manufg. Co., Box 2966.
Boston	Geo. H. Shapley	Silver Lake Co., 78 Chauncy St.
Boston	Willis S. Shepard	Am. Net & Twine Co., 34 Commercial St.
Boston	Lewis R. Speare	Mill Supplies, 369 Atlantic Ave.
Boston	Joseph Stone	53 State St., Room 949.
Boston	Winthrop Thayer	1015 Tremont Bldg.
Boston	James P. Tolman	Samson Cordage Works, 115 Congress St.
Boston	Frank H. Underwood	Dodge Manufg. Co., 137 Purchase St.
Boston	Erving Y. Woolley	152 Congress St.
Brockton	Alvin Woodman	32 Wilder St.
Canton Junction	Joseph W. Wattles	Manufacturers' Supplies.
Chicopee Falls	Henry A. Bailey	Chicopee Manufg. Co.
Clinton	William G. Nichols	Lancaster Mills.
Clinton	George P. Taylor	Lancaster Mills.
Clinton	George W. Weeks	
Fall River	F. S. Akin	Cornell Mills.

Fall River	Nathaniel B. Borden	Barnard Manufg. Co.
Fall River	Richard B. Borden	Treas. Troy C. & W. Manufg. Co.
Fall River	Thomas J. Borden	Pres. Richard Borden Manufg. Co., Box 18.
Fall River	George A. Chace	Bourne Mills.
Fall River	Simeon B. Chase	King Phillip Mills.
Fall River	John A. Collins, 73 Cottage St.,	Am. Linen Co.
Fall River	B. D. Davol	P. O. Box 418.
Fall River	David H. Dyer	Mill Eng., 7 Pocasset Bank Bldg.
Fall River	William Evans	Richard Borden Manufg. Co.
Fall River	Daniel Gilligan	Pocasset & Metacomet Mills.
Fall River	John Gregson	Merchants Mfg. Co.
Fall River	John F. Hamlet	P. O. Box 160.
Fall River	Samuel E. Hathaway	Fall River Iron Works.
Fall River	William Hathaway	Barnard Mfg. Co.
Fall River	William B. Hawes	North Dighton Cotton Co.
Fall River	George H. Hills	Davol Mills.
Fall River	Philip A. Mathewson	Chace Mills, Box 607.
Fall River	Arnold B. Sanford	Sanford Spinning Co.
Fall River	Charles M. Shove	Granite Mills, Box 45.
Fall River	Abbott E. Slade	Laurel Lake Mills.
Fall River	Albert A. Sweet	King Philip Mills, 969 Charles St.
Fall River	Richard Thackeray	Weetamoe Mills.
Fall River	James Waring	Narragansett Mills.
Fiskdale	Oscar B. Truesdell	Fiskdale Mills.
Fitchburg	George P. Grant, Jr.	Grant Yarn Co.
Fitchburg	Arthur H. Lowe	Parkhill Manufg Co.
Fitchburg	David Lowe	Parkhill Manufg. Co.
Fitchburg	Warren M. Orswell	Orswell and Nockedge Mills.
Fitchburg	Thomas C. Sheldon	Fitchburg Duck Mills.
Fitchburg	Walter F. Stiles	Nockedge & Orswell Mills.
Fitchburg	Ralph E. Thomspon	Parkhill Manufg. Co.
Griswoldville	James C. Deane	Griswoldville Manufg. Co.
Holyoke	Joseph M. Dunham	Merrick Thread Co.
Holyoke	Ernest Lovering	Lyman Mills.
Holyoke	C. W. Rider	Merrick Thread Co.
Hopedale	Eben S. Draper	Geo. Draper & Sons.
Hopedale	George A. Draper	Geo. Draper & Sons.
Hopedale	George Otis Draper	Geo. Draper & Sons.
Hopedale	William F. Draper	Geo. Draper & Sons.
Hopedale	William F. Draper, Jr.	Geo. Draper & Sons.
Housatonic	T. G. Ramsdell	Monument Mills.
Indian Orchard	C. E. W. Dow	Metallic Drawing Roll Co.
Indian Orchard	William C. Godfrey	Indian Orchard Mills.
Indian Orchard	Charles J. Goodwin	Indian Orchard Mills.
Indian Orchard	Henry C. Spence	Metallic Drawing Roll Co.

Lawrence	Wm. A. Barrell	Lawrence Duck Co.
Lawrence	Eugene E. Burnham	Leather Belt Man'fr, 168 Broadway.
Lawrence	Fred E. Clarke	Pemberton Co. and Methuen Co.
Lawrence	Albert W. Dimick	Atlantic Cotton Mills.
Lawrence	G. B. Emmons	Emmons Loom Harness Co., Box 203
Lawrence	James I. Milliken	Everett Mills.
Lawrence	Roscoe S. Milliken	Pemberton Co.
Lawrence	Walter E. Parker	Pacific Mills.
Lawrence	Robert Redford	Arlington Mills.
Lawrence	William F. Sherman	Atlantic Cotton Mills.
Lawrence	Francis H. Silsbee	Pacific Mills.
Lawrence	George W. Towne	Arlington Mills.
Lawrence	William D. Twiss	Everett Mills.
Lawrence	William S. Whitney	Washington Mills Co.
Leicester	Chas. A. Denny	American Card Clothing Co.
Lowell	George E. Ames	Lawrence Manufg. Co.
Lowell	Edward N. Burke	Lowell Machine Shop.
Lowell	W. W. Carey	Wood Machinery Builder.
Lowell	Clarence N. Childs	Supt. Hamilton Manufg. Co.
Lowell	Jeremiah Clark	277 Dutton St., Textile Machinery.
Lowell	Alfred Clarke	Eastern Elec. Light & Stor. Bat. Co
Lowell	Alonzo A. Coburn	Whitehead Machine Co.
Lowell	A. G. Cumnock	Boott Cotton Mills.
Lowell	Albert W. Danforth	881 Bridge St.
Lowell	Edward P. Dennis	Lowell Machine Shop.
Lowell	William A. Eastman	Lowell Hosiery Co.
Lowell	T. C. Entwistle	Manfr. Cotton Machinery.
Lowell	Frederick A. Flather	Lowell Machine Shop.
Lowell	Royal W. Gates	Josiah Gates & Sons.
Lowell	John J. Hart	Merrimac Print Works.
Lowell	John H. Haworth	Haworth & Watson Manufg. Co.
Lowell	James G. Hill	Lawrence Manufg. Co.
Lowell	George L. Hooper	Shaw Stocking Co.
Lowell	Alvin S. Lyon	Lowell Manufg. Co.
Lowell	Rufus A. Maxfield	
Lowell	Geo. F. Morgan	Lowell Machine Shop.
Lowell	Albert H. Morton	Kitson Machine Co.
Lowell	Oliver H. Moulton	Hamilton Manufg. Co.
Lowell	Franklin Nourse	Lawrence Manufg. Co.
Lowell	John W. Pead	Merrimac Manufg. Co.
Lowell	Haven C. Perham	Kitson Machine Co.
Lowell	M. A. Rawlinson	Tremont & Suffolk Mills.
Lowell	Charles H. Richardson	Appleton Co.
Lowell	Wm. S. Southworth	Mass. Cotton Mills.
Lowell	Earl A. Thissell	Amasa Pratt & Co.
Lowell	Edward W. Thomas	Tremont and Suffolk Mills.
Lowell	Jude C. Wadleigh	Mass. Cotton Mills.

Lowell	Walter S. Watson	Haworth & Watson Manufg. Co.
Lowell	Channing Whitaker	Lowell Machine Shop.
Lynn	C. J. H. Woodbury	Secy. and Treas.
Manchaug	Eben C. Willey	Manchaug Co.
Methuen	Lewis E. Barnes	Methuen Co.
Millbury	Fred W. Moore	Cordis Mills.
Millbury	Henry M. Wilcox	John Rhodes Warp Co.
Millbury	Theop. W. Wilmarth	Millbury Cotton Mills.
New Bedford	George A. Ayer	City Manufg. Corp.
New Bedford	Robert Burgess	Pierce Manufg. Corp.
New Bedford	Byron F. Card	New Bedford Manufg. Co.
New Bedford	Chas. C. Diman	Whitman Mills.
New Bedford	P. Y. DeNormandie	Potomska Mills.
New Bedford	Frank R. Hadley	Bennett Manufg. Co.
New Bedford	Henry A. Holcomb	New Bedford Boiler Co.
New Bedford	William J. Kent	Wamsutta Mills.
New Bedford	Nathaniel B. Kerr	Grinnell Manufg. Corp.
New Bedford	Walter H. Langshaw	Dartmouth Manufg. Corp.
New Bedford	Stephen C. Lowe	Mill Supplies.
New Bedford	Andrew G. Pierce, Jr.	Pierce Manufg. Corp.
New Bedford	Wm. R. West	830 Purchase St.
Newburyport	A. S. Winslow	Peabody Mills.
Newton	Josiah G. Coburn	
Newton Upper Falls	Frank J. Hale	Pettee Machine Works.
Newton Upper Falls	R. P. Snelling	Pettee Machine Works.
Newton Upper Falls	William B. Threlfall	Pettee Machine Works.
North Adams	Chas. W. Dennett	Johnson Manufg. Co.
Northbridge	Henry S. Houghton, Jr.	Paul Whitin Manufg. Co.
Northbridge	Henry T. Whitin	Paul Whitin Manufg. Co.
North Cambridge	Colin C. Bell	Laminar Fibre Co.
North Oxford	Edwin N. Bartlett	Sigourney and Rockdale Mills.
North Plymouth	Gideon F. Holmes	Plymouth Cordage Co.
Oakdale	William B. Fitz	W. Boylston Manufg. Co.
Oakdale	Alfred N. Whiting	L. M. Harris Manufg. Co.
Salem	William P. McMullen	Naunkeag Steam Cotton Co.
Saundersville	Thomas Wilmarth	Saunders Cotton Mills.
Shattuckville	Clifton L. Field	Massaemit Yarn Mills.
Shattuckville	Frank S. Field	Massaemit Yarn Mills.
South Hadley Falls	William R. Hill	Glasgow Manufg. Co.
Taunton	Wm. H. Bent	Mason Machine Works.
Taunton	John J. Connell	Cohannet Mills.
Taunton	Peter H. Corr	Cotton & Cotton Yarns.
Taunton	Thos. G. Cox	Mason Machine Works, Box 316.
Taunton	P. T. Creed	Hopewell Mills.
Taunton	Herbert Fisher	
Taunton	Abbott F. Lawrence	Nemasket Mills, Box 125.

Taunton	Henry M. Lovering	Whittenton Manufg. Co.
Taunton	William M. Lovering	Whittenton Manufg. Co.
Taunton	Chas. L. Macomber	Nemasket Mills.
Taunton	John Tempest Meats	Mason Machine Works.
Taunton	Herbert H. Shumway	Corr Manufg. Co.
Taunton	James W. Taylor	Canoe River Mills.
Thorndike	Charles H. Hobbs	Thorndike Co.
Three Rivers	Roscius C. Newell	Palmer Mills.
Turners Falls	Samuel L. Parker	Turners Falls Cotton Mills.
Waltham	Chas. L. Bailey	Boston Manufg. Co.
Waltham	Chas. E. Getchell	Waltham Bleachery and Dye Works.
Waltham	William G. McLoon	Boston Manufg. Co.
Ware	George E. Tucker	Otis Co.
Webster	A. M. Hathaway	H. N. Slater Mills.
Webster	Henry C. Phillips	H. N. Slater Mills.
West Boylston	F. H. Rice	Holbrook Mills, Box 47.
Westfield	Arthur W. Warren	W. Warren Thread Works.
West Warren	James W. Brown	Warren Cotton Mills.
Whitinsville	Alfred E. Adams	Whitinsville Cotton Mills.
Whitinsville	Josiah M. Lasell	The Whitin Machine Works.
Whitinsville	Oscar L. Owen	Whitin Machine Works.
Whitinsville	Arba C. Slater	Linwood Mills.
Whitinsville	Cyrus A. Taft	Whitin Machine Works.
Whitinsville	Arthur F. Whitin	Saunders C. Mills & Whitinsville C. Mills.
Whitinsville	G. Marston Whitin	The Whitinsville Machine Works.
Wilkinsonville	Ernest E. Clark	Sutton Manufg. Co.
Williamstown Sta.	Roland R. Kelly	Williamstown Manufg. Co.
Worcester	Henry F. Harris	W. Boylston Manufg. Co., Box 282.
Worcester	C. H. Hutchins	Knowles Loom Works.
Worcester	John M. Russell	Knowles Loom Works.
Worcester	Justin A. Ware	Crompton Loom Works.

RHODE ISLAND.

Albion	Andrew J. Currier	Valley Falls Co.
Allenton	R. A. Gray	Rodman Manufg. Co.
Anthony	Albert Knight	Quidnick Mills.
Ashton	Arthur H. Gulliver	Lonsdale Co.
Bayside, Warwick	Abel T. Atherton	
Central Falls	Stephen L. Adams	Stafford Manufg. Co.
Central Falls	O. B. Parker	U. S. Cotton Co.
Central Falls	George E. Sherman	
Centreville	Harold Lawton	Warwick Mills.
Centreville	J. Colby Lewis	Centreville Cotton Co.
Centreville	Robert B. Treat	Centreville Cotton Mills.

Crompton	Charles D. Robinson	Crompton Co.
Davisville	Walter B. Knight	Reynolds Manufg. Co.
Georgiaville	Herbert R. Farnum	Bernon Mills.
Greenville	Reuben Pilling, Jr.	The Granite Mills Co.
Manville	Charles Henry Savage	Manville Co.
Natick	George E. Spofford	Natick Mill.
Pawtucket	William P. Dempsey	Dempsey Bleachery & Dye Works.
Pawtucket	David Jackson	Jackson Pat. Shell Roll Co.
Pawtucket	J. E. Jenckes	The E. Jenckes Manufg. Co.
Pawtucket	W. E. Keach	57 Harrison St., E. Jenkes Manufg. Co.
Pawtucket	Jas. R. MacColl	Lorraine Manufg. Co.
Peace Dale	William C. Greene	Peace Dale Manufg. Co.
Phenix	Jesse A. Knight	Harris Manufg. Co.
Pontiac	W. H. Summersby	Pontiac Mill and Bleachery.
Providence	Charles T. Aldrich	Aldrich Manufg. Co., Box 34.
Providence	William Ames	Fletcher Manufg. Co.
Providence	George R. Babbitt	American Oil Co., 182 So. Water St.
Providence	Truman Beckwith	Dyerville Manufg. Co., Box 171.
Providence	D. Russell Brown	Brown Bros. Co.
Providence	H. Martin Brown	Brown Bros. Co.
Providence	E. C. Bucklin	Treas. Harris Manufg. Co. and Interlaken Mills, Box 289.
Providence	Fred A. Chase	Mill Supplies, F. A. Chase & Co.
Providence	Charles H. Child	Brown Bros. Co., Box 890.
Providence	Frank B. Comins	Aerphor Co., Box 1555.
Providence	Frederick I. Dana	Thomas Phillips Co.
Providence	A. Lockwood Danielson	Quinebaug Co., Box 900.
Providence	J. DeForest Danielson	Lockwood Co.
Providence	John W. Danielson	Lockwood Co.
Providence	R. H. Deming	Cotton Merchant, 10 So. Water St.
Providence	J. Herbert Foster	Cotton Merchant.
Providence	John R. Freeman	Mfrs. Mutual Fire Ins. Co.
Providence	George A. Fuller	American Card Clothing Co.
Providence	William Gammell	Berkeley Co.
Providence	William B. Gowdey	Mill Supplies, Box 707.
Providence	William S. Granger	Granger Foundry & Machine Co.
Providence	Frederick Grinnell	Gen. Fire Extinguisher Co.
Providence	Z. D. Hall	B. B. & R. Knights Mills.
Providence	John H. Hambley	Quidnick Manufg. Co.
Providence	A. Walter Harris	A. W. Harris Oil Co., 326 S. Water St.
Providence	Elisha H. Howard	Harris Manufg. Co.
Providence	Joseph H. Kendrick	American Supply Co., Box 850.
Providence	John M. Kimball	Slatersville Mills.
Providence	Stephen A. Knight	Hebron Manufg. Co., Box 820.
Providence	Charles W. Lippitt	Silver Spring B. & D. Co.
Providence	Henry F. Lippitt	Social and Manville Cos.
Providence	Charles R. Makepeace	Mill Engineer, Box 973.

Providence	F. H. Maynard	Gen. Fire Extin. Co.
Providence	Thomas Mayor	Textile Machinery, 26 Olney St.
Providence	George C. Phillips	Thos. Phillips Co.
Providence	William C. Peirce	Elizabeth Mills, 564 Eddy St.
Providence	Stephen Minot Pitman	Narragansett Fire Ins. Co.
Providence	Thomas C. Powell	
Providence	Richard H. Rice	Rice & Sargent, Steam Engine Co.
Providence	Frank P. Sheldon	Mill Engineer.
Providence	George W. Stafford	Knowles Loom Works.
Providence	Daniel J. Sully	Cotton Broker.
Providence	Edward P. Taft	Ponemah Mills, Box 1443.
Providence	Robert W. Taft	Coventry Co. and Bernon Mills.
Providence	D. M. Thompson	Corliss Steam Engine Co.
Providence	A. Curtis Tingley	Nat. Ring Traveler Co.
Riverpoint	Arthur F. Brackett	Riverpoint and Arctic Mills.
Slatersville	Wm. P. Holt	Slatersville Mills, Box 315.
Valley Falls	Arnold B. Chace, Jr.	Woonsocket Mills.
Warren	Arnold Schaer	Warren Manufg. Co.
Warren	John Waterman	Warren Manufg. Co.
Westerly	Wm. W. Blades	Crefeld Mills.
Westerly	W. Marshall Taylor	Clark Thread Co.
Wickford	Joseph Warren Greene	Hamilton Web Co.
Woonsocket	Malcolm Campbell	Woonsocket Mach. & Press Co.
Woonsocket	Chas. H. Gorton	Ballou Mill.
Woonsocket	Frank Harris	Hamlet Mills.
Woonsocket	Chas. H. Merriman, Jr.	Social and Nourse Mills.
Woonsocket	Ariel C. Thomas	Clinton Manufg. Co.
Woonsocket	Charles E. Thomas	Forestdale Manufg. Co.
Woonsocket	A. Tenny White	Globe Mill.

CONNECTICUT.

Baltic	Robert Rennie Taft	Baltic Power Co.
Bozrahville	Ira J. Martin	Bozrahville Manufg. Co.
Dayville	C. H. Truesdell	Attawaugan Co.
Jewett City	Harry W. Kimball	Jewett City Mills.
Jewett City	James O. Sweet	Ashland Cotton Co.
Jewett City	A. A. Young, Jr.	Jewett City Mills.
Jewett City	Adelbert R. Young	Ashland Cotton Co.
Killingly	H. C. Atwood	Williamsville Manufg. Co.
Killingly	W. E. Atwood	Williamsville Manufg. Co.
Montville	W. S. Hume	Pequot Mills.
New Hartford	Robert R. Smith	Greenwoods Co.
New Haven	George S. Barnum	The Bigelow Co.
No. Grosvenordale	Frank M. Messenger	Grosvenor Dale Co.
Norwich	W. N. Blackstone	Attawaugan Co.

Norwich	W. R. Burnham	Uncasville Manufg. Co.
Norwich	C. H. Frisbie	Attawaugan Mills.
Norwich	Marcellus Gould	Falls Co.
Norwich	W. G. Henderson	Shetucket Co.
Norwich	Moses Pierce	Aspinook Co.
Putnam	George W. Holt	Monohansett Manufg. Co.
Putnam	George A. Vaughan	Putnam Manufg. Co.
Taftville	Joseph D. Aiken	Ponemah Mills.
Taftville	John Eccles	Ponemah Mills.
Wauregan	James A. Atwood	Wauregan Mills.
Wauregan	John Walter Atwood	Wauregan Mills.
Willimantic	E. S. Boss	Willimantic Linen Co.
Willimantic	John Scott	Willimantic Linen Co.

NEW YORK.

Capron	W. H. Cloher, Jr.	Utica Cotton Co.
Cohoes	David S. Johnston	Cohoes Foundry & Machine Co.
Cohoes	J. E. Prest	Harmony Mills.
New York City	George Arms	Grand Hotel.
New York City	Edwin H. Baker	Bliss, Fabyan & Co., Box 2899.
New York City	Edward R. Ballou	Brighton Mills, 541 W. 23d St.
New York City	Arthur B. Mann	99 Franklin St., P. O. Box 465.
New York City	Dudley T. Lyall	Brighton Mills, 541 W. 23d St.
New York City	William L. Lyall	J. & W. Lyall Loom and Machine Works, 541 W. 23d St.
New York City	Duncan Parmly	Johnson Mfg. Co., 160 Broadway
Oneida Co.	John P. Campbell	New York Mills.
Oswego	George H. Sayward	Standard Yarn Co.
Utica	D. W. Gray	Skenandoa Cotton Co.
Utica	Henry F. Mansfield	Utica Steam Cotton Mills.
Victory Mills	John O. Hannum	Saratoga Victory Manufg. Co.

NEW JERSEY.

Gloucester City	Philip H. Fowler	
Jersey City	Ernest Bridge	Jas. Chadwick & Bro. Ltd.
Millville	Wm. B. Munroe	Millville Manufg. Co.
Millville	John K. Russell	May's Landing Water Power Co., and Millville Manufg. Co.
Newark	J. William Clark	Clark Thread Co.
Newark	H. E. Walmesley	Clark Thread Co.
Newark	William Whittam, Jr.	Clark Mile End Spool Cotton Co.
Paterson	John W. Ferguson	Mill Engineer and Builder.

PENNSYLVANIA.

Lancaster	S. S. Spencer	Conestoga Steam Mills.
Philadelphia	James Butterworth	H. W. Butterworth & Sons.
Philadelphia	Edward W. France	Phila. Textile Schools.
Philadelphia, Frankfort Sta.	Richard Garsed	Wingohocking Mills.
Philadelphia	George Wood	Millville Manufg. Co., 626 Chestnut [St.
Trainer	William E. Trainer	Linwood Mills.

DELAWARE.

Wilmington	William P. Bancroft	Joseph Bancroft & Sons Co.

MARYLAND.

Baltimore	James S. Gary	Gary Manufg. Co.

NORTH CAROLINA.

Charlotte	H. S. Chadwick	Dover Yarn Mills and Dilling Cotton Mills.
Charlotte	E. A. Smith	Charlotte Supply Co.
Charlotte	D. A. Tompkins	Atherton Mills.
Henrietta	Fred S. Mosher	Henrietta Mills.
Kings Mountain	Philip S. Baker	Crowders Mt. Cotton Mills.
Kings Mountain	F. Dilling	Dilling Cotton Mills.
Kings Mountain	C. E. Falls	Enterprise Manufg. Co.
Mountain Island	W. T. Jordan	Mt. Island Manufg. Co.
Pineville	J. P. Wilson	Dover Cotton Mills.
Reidsville	John W. Arrington	Edna Cotton Mills.

SOUTH CAROLINA.

Columbia	Charles K. Oliver	Columbia Mills Co.
Columbia	W. B. Smith Whaley	Mill Engineer.
Gaffney	H. D. Wheat	Gaffney Manufg. Co.
Lancaster	Leroy Springs	Lancaster Cotton Mills.
Langley	Arthur T. Smith	Langley Manufg. Co.
Newberry	Edward B. Wilbur	Newberry Cotton Mills.
Pelzer	B. F. Guy	Pelzer Manufg. Co.
Pelzer	Ellison A. Smyth	Pelzer Manufg. Co.
Walhalla	Horace L. Hayden	Walhalla Cotton Mills.

GEORGIA.

Atlanta	J. F. Dickinson	So. Belting Co.
Atlanta	Henry E. Fisher	Atlanta Cotton Mills.
Atlanta	James R. Pearce	Fulton Bag and Cotton Mills.
Augusta	Otis G. Lynch	Enterprise Manufg. Co.

Augusta	Joel Smith	J. P. King Mfg. Co.
Augusta	George R. Stearns	Riverside Mills.
Griffin	Albert G. Martin	Kincaid Manufg. Co., Box 272.
LaGrange,	Samuel Hale	Dixie Cotton Mills.
Lindale, Floyd Co.	Arthur W. Hunking	Mass. Mills in Georgia.
Savannah	Wm. A. Robinson	Savannah Cotton Mills.

TENNESSEE.

Nashville	T. B. Dallas	Phenix Cotton Mills.

MISSOURI.

St. Louis	D. C. Ball	Ball-Warren Commission Co.
St. Louis	Jerome Hill	Jerome Hill Manufg. Co., 116 So. Main St.

LOUISIANA.

New Orleans	S. Odenheimer	Lane Mills.

ALABAMA.

Alabama City	Osmon B. Tilton	Dwight Manufg. Co.
Huntsville	T. W. Pratt	West Huntsville Cotton Mills.

TEXAS.

Dickinson	Lawrence V. Elder	
Galveston	D. M. Ehrlich	Galveston Cotton Mills.
Temple	W. T. Bessonette	Temple Gin and Compress Co.
Waco	Jno. Hopkinson	Slayden & Kirksey Woolen Mills.

CANADA.

Hamilton, Ont.	Charles Owen Dexter	Can. Colored Cotton Mills Ltd.
Hamilton, Ont.	Farquharson J. Muir	Can. Colored Cotton Mills Ltd.
Montreal, P. Q.	Alfred Hawkesworth	Merchants Manufg. Co.
Montreal, P. Q.	Fred Hawkesworth	Merchants Manufg. Co.
Valleyfield, P. Q.	Fred C. Lacey	Montreal Cotton Co.
Valleyfield, P. Q.	Louis Simpson	Montreal Cotton Co.

NEW BRUNSWICK.

St. John	John H. Parks	Wm. Parks & Sons, Ltd.

RECAPITULATION.

LOCATION OF MEMBERSHIP.

Maine	19
New Hampshire	25
Vermont	2
Massachusetts	223
Rhode Island	86
Connecticut	27
New York	15
New Jersey	8
Pennsylvania	6
Delaware	1
Maryland	1
North Carolina	10
South Carolina	9
Georgia	10
Alabama	2
Tennessee	1
Missouri	2
Louisiana	1
Texas	4
Canada	6
New Brunswick	1
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In Memoriam.

FRANK HASKELL.

FRANK HASKELL died suddenly from neuralgia of the heart on the evening of July 24th, at Windham, Me., where he was taking a short vacation.

Mr. HASKELL was born in Rockport, Mass., and at the age of fourteen years his parents moved to Westbrook, Me., and after his school course he was employed in various capacities in the mill, succeeding his father as agent. He was also one of the founders of the Haskell Silk Company, organized in 1874. He had full charge of the Westbrook Manufacturing Company, holding both positions of treasurer and agent. He was a member of the Congregational Church and took an active interest in all public affairs, having served the city in various elective offices.

JOSEPH S. LUDLAM.

JOSEPH S. LUDLAM, agent of the Merrimack Manufacturing Company, Lowell, Mass., died suddenly on August 4th, bringing to an end a life of remarkable force and activity. He was born near Cape May in New Jersey, in the year 1838, being a descendant of the early Long Island settlers and a direct descendant of several who were active in the war of the Revolution. Early in life he went to sea and rose to be captain of vessels

engaged in the East India trade. He then entered the service of the Chinese government, first as a pilot and later as commander of the troops during the Tai Ping Rebellion, being closely associated with the celebrated Chinese Gordon. After sixteen years of life in the Orient, he travelled in Europe, and was later superintendent of a copper mine in the Lake Superior region, from which place he came to Lowell as agent of the Merrimack Manufacturing Company about twenty-one years ago.

Mr. LUDLAM was a man of strong body and active mind and his various resources enabled him to excel in every undertaking which engaged his attention. He was a brilliant conversationalist and his reminiscences of travel and adventure rendered him a most desirable companion.

He took great interest in the hospital owned and controlled by the corporations at Lowell, devoting much time to its management, and introduced many improvements which brought it to a condition which made it compare favorably with the larger hospitals of the country.

He was President of the Association from 1886 to 1888.

GEORGE P. GRANT.

GEORGE P. GRANT died suddenly of appendicitis, in Boston, August 8, 1896. There was scarcely a better known mill man in New England, and the news came with a great shock to his large circle of friends and acquaintances.

Thirty-seven years ago Mr. GRANT began a noteworthy term of service with Greene & Daniels of Central Falls, R. I., who then operated what was known as the Moies & Jencks mill. When the war opened he enlisted in Co. H. 9th R. I. Vol. Infantry and served as first corporal a full term. Upon his return he reassumed his duties with Greene & Daniels, leaving in 1868 to engage in business in Worcester. A year later Mr. GRANT,

though scarcely twenty-five years old, returned to Pawtucket as superintendent of the new mill that Greene & Daniels had just started. In 1877, when the concern was incorporated as the Greene & Daniels Manufacturing Company, he was made agent, and in 1886 he was also elected treasurer. These positions he held until May, 1895, when he severed his connection with the concern.

It was largely due to his efforts that the Grant Yarn Company of Fitchburg, Mass., was founded in 1892. He was chosen its first president and held the position at the time of his death.

In spite of his busy life Mr. GRANT found time to discharge several public trusts. He had been president of the Council of Lincoln, R. I., and served that town four terms as representative to the General Assembly, declining further re-nomination. He was the first president of the Lincoln Republican Association, and continued to the last as a director of the Pacific National Bank of Pawtucket, and the Atlantic Mutual Fire Insurance Company of Providence. He was a member of the Central Falls Baptist Church, with the good works of which he was ever identified.

Mr. GRANT was a self-made man in the fullest sense of the word, who won his success step by step, finding time as he went along to serve his country and community. He had just entered into that leisure to which his forty years of active labor had entitled him, a leisure that would have been fruitful in its benefits to himself and many others. Death came amid the fulness of life, and the world is so much poorer.

G. A. THUDIUM.

G. A. THUDIUM died at Malden, Mass., June 8, 1896, at the age of forty-seven. He was a man of great skill and experience in the preparation of dyes having been brought up in that business under A. Eichler of Philadelphia, where he was at the head

of that department for several years. He then held a similar position for the Crump Label Co., at Montclair, New Jersey, from which place he went to Springfield, Mass., for the Heckla Card Co., returning to Philadelphia under the service of Schulze, Berge & Koechel of New York, representing the Victoria Size, a compound whose formula he originated, and which he sold among the mills. In the course of this work he became widely known in the textile manufacturing circles in the New England States.

He was very proficient in his occupation and made many friends and acquaintances, being a 32d degree Mason and also a member of several other organizations, as well as one of the first of the associate membership of this Association when that classification was formed. He left a wife, two sons and three daughters.

CALL FOR MEETING.

NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION,

Profile Meeting, No. 61.

BOSTON, MASS., Sept. 1, 1896.

Dear Sir:

The stated semi-annual meeting of the Association will be held at the Profile House, New Hampshire, on September 22, 23 and 24, 1896. The rates at the Profile House will be reduced to three dollars a day to members of the Association and their guests.

The train will leave Boston from the Union Station, Causeway St., on the Southern and White Mountains Divisions of the Boston & Maine Railroad, Tuesday, Sept. 22, at 9.30 A. M., leaving Lowell at 10.09 A. M., Nashua Junction at 10.34 A. M., and Manchester at 11.01 A. M. Special cars will take the party for the Profile House.

The train stops at Plymouth for lunch from 1.10 to 1.40 P. M., and arrives at the Profile House at 4.35 P. M.

Trains returning by the same route leave Profile House at 8.50 A. M. and 12.50 P. M., arriving in Boston at 4.45 P. M. and 8.30 P. M. Or leave Profile House at 8.45 A. M. and 1.25 P. M., by stages through the Franconia Valley to North Woodstock and thence by rail to Plymouth, reaching Boston at 4.45 and 8.30 P. M.

The return railroad ticket by this route is good for the railroad travel from North Woodstock to Boston, but for the stage ride a charge of $1.25 will be made. It will be necessary to engage seats on the stage soon after arrival at the Profile House, in order that arrangements may be made for the accommodation of all.

The return from the Profile House to Boston can be made through the Crawford Notch by way of Fabyans, North Conway and Eastern Division to Boston. Leave Profile House at 7.30 A. M., or 12.50 P. M., and arrive at Boston at 3.20 P. M. or 8.25 P. M.

There will be two kinds of round trip tickets for this trip: one being from Boston to the Profile House, through the Southern and White Mountains Divisions via Bethlehem Junction and return the same way. The other ticket will be good for passage from Boston to the Profile House through the Southern and White Mountains Divisions and return through the Crawford Notch and Eastern Division of the Boston & Maine Railroad to Boston.

The price of the railroad tickets for the round trip has been reduced to six dollars, from Boston, Lowell, Lawrence and Salem.

Round trip tickets at proportionate rates from Worcester, Nashua Junction and Manchester.

Those taking trains for the Profile House from other stations may make inquiries of the Station Agent relative to round trip tickets.

Members should decide before leaving which route they prefer, and purchase tickets accordingly.

The headquarters of the Association will be at the Profile House, and the meetings will be held in the ball room.

The rooms will be assigned to members of the party, after leaving Plymouth, by the room-clerk of the Profile House, and cards bearing the numbers of their rooms will be exchanged for room keys at the hotel, without any necessity of registering.

Those who arrive on other trains will register and be assigned to rooms in the usual manner.

It will add to the convenience of everybody if the members promptly fill out and mail the enclosed postal card.

Those who are proposed for membership are invited to attend the meeting and to participate in the discussion.

The programme is arranged with a view of leaving afternoons free for excursions to the numerous points of interest in the neighborhood, but afternoon meetings may be held if the weather is unpleasant.

Members are at liberty to invite guests, including ladies, to accompany the party.

PROGRAMME.

Tuesday, September 22, 1896, 8 P. M.

COTTON MANUFACTURING IN JAPAN.
Hon. ROBERT P. PORTER, Cleveland, Ohio.

Business.

Wednesday, September 23, 9.30 A. M.

THE MANUFACTURE OF FINE YARNS.
Mr. HERBERT E. WALMESLEY, Newark, N. J.

THE USE OF THE COMBER IN COTTON MANUFACTURE.
Mr. E. W. ATKINSON, Boston, Mass.

TOPICAL QUESTION.

73. How fast can a combing machine be run and what production will it make, and give satisfactory work?

CONDENSED COTTON YARN AND THE CONDENSER CARD.
Mr. CHRISTOPHER P. BROOKS, Charlotte, N. C.

TOPICAL QUESTIONS.

74. What is the best taper or length of wind for mule cops on number 37 filling?

75. Can as marketable goods be made from frame yarns as from mule yarns?

76. What are the best means to prevent waste of all kinds in a mill?

DIFFERENTIAL MOTIONS.
Mr. JOSEPH NASMITH, Manchester, England.

TOPICAL QUESTION.

77. What are the best methods of allowance for depreciation of mill buildings and machinery?

Wednesday, 8 P. M.

WHAT THE PHILADELPHIA MUSEUMS CAN DO FOR THE NEW ENGLAND COTTON MANUFACTURERS.
WILLIAM P. WILSON, Sc. D., Philadelphia, Pa.

SUGGESTIONS FOR THE FUTURE WORK OF THE ASSOCIATION.
Mr. RUSSELL W. EATON, Brunswick, Me.

TOPICAL QUESTION.

78. Suggestions from each member on the future work of the Association. All members present are requested to be prepared to offer some suggestions.

A FEW SUGGESTIONS TO MANAGERS AND SUPERINTENDENTS.
Mr. JOHN S. ADAMS, JR., Adams, Mass.

TOPICAL QUESTION.

79. What is the best way to pay section hands in a weaving room where plain, twill, fancy, sateen, lappett, and Jacquard looms are to be run?

Thursday, September 24, 9.30 A. M.

LOOMS AND LOOM-FIXERS; WEAVERS AND WEAVING ROOMS.
Mr. ALFRED HAWKESWORTH, Montreal, P. Q.

TOPICAL QUESTION.

80. What is the best temperature and humidity in cotton mills where fine and coarse goods are to be woven?

POWER REQUIRED TO DRIVE GINGHAM LOOMS.
Mr. GEORGE W. WEEKS, Clinton, Mass.

PRACTICAL THEORY OF STEAM MAKING FROM SHOVEL TO STOP VALVE.
Mr. WINTHROP THAYER, Boston, Mass.

THE HEATH METALLIC BALE.
Mr. JOSEPH H. KENDRICK, Providence, R. I.

POWER TRANSMISSION.
Mr. FRANK H. UNDERWOOD, Boston, Mass.

ECONOMICAL ARRANGEMENTS FOR TRANSPORTATION OF COTTON FROM STOREHOUSE TO PICKERS; AND FROM WEAVE ROOMS TO CLOTH HALL.
Mr. EDWARD W. THOMAS, Lowell, Mass.

Also other papers to be announced later and Topical Questions which will be contained in the programme.

Mail and telegrams to be sent to the Profile House, New Hampshire.

Those members who have overlooked their annual settlements will confer a favor by giving the matter their attention.

Members are requested to receipt for the last Transactions for the spring meeting unless they have already done so.

Members are especially requested to give their fellow members the benefits of their experience. Those who will not be able to attend the meeting can send their discussions in writing to the Secretary, to be read in their absence.

Blank proposals for membership can be obtained at the rooms of the Association or from the Secretary, P. O. Box 3672, Boston, Mass., and it is important that nominations for membership be in his hands as early as convenient.

By order of the Board of Government,

C. J. H. WOODBURY,

Secretary.

THE EXCURSION.

The larger portion of those attending the meeting to the number of one hundred and twenty left Boston from the Union Station at 9.30 A. M., occupying four parlor cars, and stopped at the Pemigewassett House, Plymouth, N. H., for dinner, and reached the Profile House without especial incident apart from the arrangements as stated in the call for the meeting.

The members from Maine came in a train under arrangements made by Mr. RUSSELL W. EATON of the Board of Government of the Association.

PROCEEDINGS.

The sixty-first meeting of the New England Cotton Manufacturers' Association was held pursuant to legal notice at the Profile House, N. H., on September 22, 23 and 24, 1896. The following members and guests were present:

JOHN S. ADAMS, JR., Adams, Mass.
CHARLES B. AMORY, Boston, Mass.
FR. JAC. ANDRES, Boston, Mass.
GEORGE D. ARMSTRONG, Lewiston, Maine.
MRS. GEORGE D. ARMSTRONG, Lewiston, Maine.
H. C. ATWOOD, Killingly, Conn.
MRS. H. C. ATWOOD, Killingly, Conn.
JAMES A. ATWOOD, Wauregan, Conn.
MRS. JAMES A. ATWOOD, Wauregan, Conn.
EDWARD W. ATKINSON, Boston, Mass.
GEORGE R. BABBITT, Providence, R. I.
GEORGE S. BARNUM, New Haven, Conn.
GEORGE W. BEAN, Lewiston, Maine.
MRS. GEORGE W. BEAN, Lewiston, Maine.
GEORGE W. BEAN, JR., Lewiston, Maine.
COLIN C. BELL, North Cambridge, Mass.
MRS. COLIN C. BELL, North Cambridge, Mass.
FRANK P. BENNETT, Boston, Mass.
MRS. FRANK P. BENNETT, Boston, Mass.
FRANK P. BENNETT, JR., Boston, Mass.
J. PAYSON BRADLEY, Boston, Mass.
HENRY GORDON BRINCKERHOFF, Boston, Mass.
CHRISTOPHER P. BROOKS, Charlotte, N. C.
MRS. CHRISTOPHER P. BROOKS, Charlotte, N. C.

JOHN H. BURKHARDT, Boston, Mass.
FRANK H. BURT, Boston, Mass.
BYRON F. CARD, New Bedford, Mass.
MRS. BYRON F. CARD, New Bedford, Mass.
W. W. CAREY, Lowell, Mass.
S. I. CARPENTER, Boston, Mass.
GEORGE A. CHACE, Fall River, Mass.
MRS. GEORGE A. CHACE, Fall River, Mass.
ELEANOR S. CHACE, Fall River, Mass.
FENNER C. CHACE, Fall River, Mass.
JEREMIAH CLARK, Lowell, Mass.
FRANK B. COMINS, Providence, R. I.
JOHN J. CONNELL, Taunton, Mass.
MRS. JOHN J. CONNELL, Taunton, Mass.
CHARLES W. DENNETT, North Adams, Mass.
EDWARD P. DENNIS, Lowell, Mass.
GEORGE A. DOTY, Waltham, Mass.
C. E. W. DOW, Indian Orchard, Mass.
GEORGE OTIS DRAPER, Hopedale, Mass.
MRS. GEORGE OTIS DRAPER, Hopedale, Mass.
RUSSELL W. EATON, Brunswick, Maine.
MRS. RUSSELL W. EATON, Brunswick, Maine.
G. B. EMMONS, Lawrence, Mass.
MRS. G. B. EMMONS, Lawrence, Mass.
MISS EMMONS, Lawrence, Mass.
T. C. ENTWISTLE, Lowell, Mass.
MRS. T. C. ENTWISTLE, Lowell, Mass.
WILLIAM FIRTH, Boston, Mass.
MRS. WILLIAM FIRTH, Boston, Mass.
MISS FIRTH, Boston, Mass.
PAULINE FIRTH, Boston, Mass.
HERBERT FISHER, Taunton, Mass.
FREDERICK A. FLATHER, Lowell, Mass.
MRS. S. L. FOGG, Ware, N. H.
T. G. FOSTER, Whitinsville, Mass.
MRS. T. G. FOSTER, Whitinsville, Mass.
H. P. GARLAND, Saco, Maine.
MRS. H. P. GARLAND, Saco, Maine.
ROYAL W. GATES, Lowell, Mass.

ALFRED M. GOODALE, Boston, Mass.
MARCELLUS GOULD, Norwich, Conn.
MRS. MARCELLUS GOULD, Norwich, Conn.
SUMNER GOULD, Lowell, Mass.
R. A. GRAY, Allentown, R. I.
MRS. R. A. GRAY, Allentown, R. I.
ARTHUR H. GULLIVER, Ashton, R. I.
MRS. ARTHUR H. GULLIVER, Ashton, R. I.
FRANK J. HALE, Newton Upper Falls, Mass.
Z. D. HALL, Providence, R. I.
MRS. Z. D. HALL, Providence, R. I.
MISS EDITH HALL, Providence, R. I.
A. WALTER HARRIS, Providence, R. I.
JOHN J. HART, Lowell, Mass.
MRS. JOHN J. HART, Lowell, Mass.
WILLIAM A. HAWES, Fall River, Mass.
ALFRED HAWKESWORTH, Montreal, P. Q.
MRS. ALFRED HAWKESWORTH, Montreal, P. Q.
JOHN H. HAWORTH, Lowell, Mass.
W. G. HENDERSON, Norwich, Conn.
HENRY A. HOLCOMB, New Bedford, Mass.
C. W. HOLCOMB, New Bedford, Mass.
DAVID JACKSON, Pawtucket, R. I.
MRS. DAVID JACKSON, Pawtucket, R. I.
WILLIAM B. KEHEW, Boston, Mass.
ROLAND R. KELLY, Williamstown Sta., Mass.
MRS. ROLAND R. KELLY, Williamstown Sta., Mass.
JOSEPH H. KENDRICK, Providence, R. I.
MRS. JOSEPH H. KENDRICK, Providence, R. I.
WILLIAM J. KENT, New Bedford, Mass.
HENRY G. KITTREDGE, Boston, Mass.
STEPHEN A. KNIGHT, Providence, R. I.
ARTHUR H. LOWE, Fitchburg, Mass.
MRS. ARTHUR H. LOWE, Fitchburg, Mass.
JAMES W. LUTHER, Fall River, Mass.
MRS. JAMES W. LUTHER, Fall River, Mass.
JAMES R. MACCOLL, Pawtucket, R. I.
MISS MACGREGOR, Southport, England.
CHARLES T. MAIN, Boston, Mass.

Mrs. Charles T. Main, Boston, Mass.
E. L. Marrow, Providence, R. I.
A. P. Massey, Boston, Mass.
Thomas Mayor, Providence, R. I.
W. H. Miles, Lisbon, Maine.
Oliver H. Moulton, Lowell, Mass.
George F. Morgan, Lowell, Mass.
W. C. Nairn, North Cambridge, Mass.
William G. Nichols, South Hadley Falls, Mass.
Oscar L. Owen, Whitinsville, Mass.
Mrs. Oscar L. Owen, Whitinsville, Mass.
William D. Pennell, Lewiston, Maine.
Mrs. William D. Pennell, Lewiston, Maine.
Charles H. Richardson, Lowell, Mass.
Mrs. Charles H. Richardson, Lowell, Mass.
Miss Amanda Saxon, Lonsdale, R. I.
Louis Simpson, Valleyfield, P. Q.
Frank P. Sheldon, Providence, R. I.
Mrs. Frank P. Sheldon, Providence, R. I.
Harry C. Smith, Boston, Mass.
R. P. Snelling, Newton Upper Falls, Mass.
S. S. Spencer, Lancaster, Penn.
Mrs. S. S. Spencer, Lancaster, Penn.
A. G. Staples, Lewiston, Maine.
Mrs. A. G. Staples, Lewiston, Maine.
B. S. Terry, Providence, R. I.
Winthrop Thayer, Boston, Mass.
Mrs. Winthrop Thayer, Boston, Mass.
Edward W. Thomas, Lowell, Mass.
D. M. Thompson, Providence, R. I.
James P. Tolman, Boston, Mass.
George E. Trowbridge, Boston, Mass.
C. H. Truesdell, Dayville, Conn.
Mrs. C. H. Truesdell, Dayville, Conn.
O. B. Truesdell, Fiskdale, Mass.
Mrs. O. B. Truesdell, Fiskdale, Mass.
Herbert E. Walmesley, Newark, N. J.
James A. Walsh, Lewiston, Maine.
Mrs. James A. Walsh, Lewiston, Maine.

W. S. WATSON, Lowell, Mass.
A. S. WATTLES, Canton Junction, Mass.
JOSEPH WHITAKER, Boston, Mass.
MRS. JOSEPH WHITAKER, Boston, Mass.
MISS MARGARET WIGHT, Lowell, Mass.
WILLIAM P. WILSON, Sc. D., Philadelphia, Pa.
GEORGE WOOD, Philadelphia, Pa.
MRS. GEORGE WOOD, Philadelphia, Pa.
C. J. H. WOODBURY, Lynn, Mass.

FIRST SESSION.

PROFILE HOUSE, N. H., Sept. 22, 1896.

The Association met in the parlor of the hotel at 8 P. M., and the meeting was called to order by President ARTHUR H. LOWE in the chair.

The PRESIDENT. Gentlemen will please come to order. The Secretary will read the call for the meeting.

The Secretary read the call for the meeting as follows:

NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION,
Profile Meeting, No. 61,
BOSTON, MASS., Sept. 1, 1896.

Dear Sir:

The stated semi-annual meeting of the Association will be held at the Profile House, New Hampshire, on September 22, 23 and 24, 1896.

By order of the Board of Government,

C. J. H. WOODBURY,
Secretary.

The SECRETARY. I hereby certify that I have, in accordance with Article 14 of the Constitution, mailed copies of this notice to each member of the Association ten days at least in advance of this meeting, and that a quorum is now present.

The PRESIDENT. The next in order is the reading of the records of the last meeting.

The Secretary read the records of the sixtieth meeting, which, on motion duly seconded, were approved.

The PRESIDENT. The next business before the meeting is the election of members, and the Secretary will read the names that have been presented for membership and recommended by the Board of Government.

The Secretary read the following list of candidates for membership:

FOR ACTIVE MEMBERSHIP.

JOHN P. CAMPBELL, Supt. N. Y. Mills, New York Mills, Oneida Co., N. Y.
By Mr. C. R. MAKEPEACE.

W. H. CLOHER, JR., Agent Utica Cotton Co., Capron, Oneida Co., N.Y.
By Mr. D. W. GRAY.

P. T. CREED, Supt. Hopewell Mills, Taunton, Mass.
By Mr. HERBERT FISHER.

EDWARD W. FRANCE, Director of Philadelphia Textile Schools, Phila., Pa.
By Mr. S. S. SPENCER.

MARCELLUS GOULD, Agent Falls Company, Norwich, Conn.
By Mr. ALBERT F. KNIGHT.

FRED HAWKESWORTH, Asst. Supt. Merchants Mfg. Co., Montreal, Can.
By Mr. N. B. KERR.

DUDLEY T. LYALL, Asst. Mgr. Brighton Mills, 541 W. 23rd St., New York, N. Y.
By Mr. E. R. BALLOU.

W. H. MILES, Agent Farwell Mills, Lisbon, Maine.
By Mr. RUSSELL W. EATON.

DUNCAN D. PARMLY, Treas. Johnson Mfg. Co., and Dunbar Mills Co., 160 Broadway, New York, N. Y.
By Mr. CHARLES W. DENNETT.

T. W. PRATT, Pres. West Huntsville Cotton Mills, Huntsville, Ala.
By Mr. ARTHUR H. LOWE.

W. MARSHAL TAYLOR, Supt. Clark Thread Co., 69 Mechanic St., Westerly, R. I.
By Mr. W. W. BLADES.

GEORGE A. VAUGHAN, Supt. Putnam Mfg. Co., Putnam, Conn.
By Mr. GEORGE W. HOLT.

FOR ASSOCIATE MEMBERSHIP.

FRANK P. BENNETT, Pub. American Wool and Cotton Reporter, 148 Pearl St., Boston.
By Mr. ARTHUR H. LOWE.

HENRY GORDON BRINCKERHOFF, N. E. Mgr. Fuel Economizer Co., 53 State St., Boston.
By Mr. FREDERICK A. FLATHER.

JOHN R. FREEMAN, Pres. Mfrs. Mutual Fire Ins. Co., Providence, R. I.
By Mr. C. J. H. WOODBURY.

H. G. MCKERROW, Textile Machinery, 31 State St., Boston.
By Mr. E. W. THOMAS.

R. P. SNELLING, Treas. Pettee Machine Works, Newton Upper Falls, Mass.
By Mr. WILLIAM J. KENT.

A. CURTIS TINGLEY, Treas. National Ring Traveller Co., Providence, R. I.
By Mr. A. F. KNIGHT.

WILLIAM R. WEST, Roll Coverer, 830 Purchase St., New Bedford, Mass.
By Mr. BYRON F. CARD.

The PRESIDENT. The by-laws require that these elections shall be by ballot, and the chair will appoint Messrs. GEORGE OTIS DRAPER and WILLIAM J. KENT as a committee to collect, assort and count the ballots.

Mr. JOSEPH H. KENDRICK. Mr. President, in order to save time I move that the Secretary be authorized by the meeting to cast one ballot. By unanimous consent I think that can be done and much time saved.

The motion was seconded.

The PRESIDENT. I believe it will be legal if there is no objection to it, though in the past I think we have always balloted. But the motion is made that the Secretary cast one ballot bearing the names that have been read.

The motion was carried unanimously.

The SECRETARY. (Depositing a ballot.) I cast that as my ballot in accordance with the vote.

The PRESIDENT. The gentlemen whose names have been read are elected as members of the Association. The Secretary will now read any notices that he may have to present.

The SECRETARY. The only notice at this stage of the meeting is that the reason that some of the members were not assigned rooms and accommodations which they desired, was due to the delay in receiving answers from a number of the members as to their intention to attend the meeting. There were a number of withdrawals of acceptances and there were a number of persons putting in an appearance this morning who had not been expected, and I would say that it would be a great help to everyone attending future meetings if they could conform to the request of the Board of Government, relative to answering these questions on the postal cards sent out with notice of meeting, as promptly as possible, because it is on that basis that the preparations are made, and while the individuals may modestly assume that they count only one apiece, yet in the aggregate it makes a great deal of difference.

Mr. EDWARD W. ATKINSON. Mr. President, I would like to say one word. I do not think that our Secretary need make any apologies for the omissions that he has just mentioned, but I think that a vote of thanks of the Association is due to our Secretary for the very systematic and able way in which he has

managed all the meetings that we have had thus far. We need no apologies from him at all. I should like to move that such a vote of thanks be passed. (Applause.)

The motion was seconded.

The PRESIDENT. It is moved that a vote of thanks be extended to the Secretary for the pains which he has taken in making the arrangements for this and previous meetings.

The motion was unanimously carried.

The SECRETARY. Mr. President, this matter has taken a very unexpected turn. I was not aware that I had done anything except what is in the ordinary duties of the Secretary, but I value your good will very, very highly.

OPENING ADDRESS OF THE PRESIDENT, ARTHUR H. LOWE, FITCHBURG, MASS.

Gentlemen:—My predecessors have established the custom of an opening address by the President, accordingly, representing the Board of Government, I am pleased to welcome most heartily the members of the Association and their friends who are in attendance at this, the sixty-first semi-annual meeting of the Association. The previous meeting held among the mountains, the excursion to and the meeting held at Atlanta, are among the marked successes of this Association, and prove the wisdom of holding the autumn meetings in various places outside of Boston, where objects of pleasure and interest can be enjoyed, and where in travel and in the hotels the members are brought into closer social relations, where acquaintances and friendships are formed that shall prove of inestimable value.

The present Board of Government is unanimously of the opinion that the annual meeting should usually be held in the city of Boston. If this is to be the policy of the Association in regard to the holding of its meetings, I suggest that the Autumn

Meeting while in session, decide upon the place of holding the meeting the coming year. This will relieve the Board of Government from deciding a delicate question, will give the members a chance to express their preference, and give them a longer time to make arrangements to attend. If these autumn meetings continue as enjoyable and profitable as the last two were and as I hope this one will be, they will be looked forward to and planned for and anticipated by the members as one of their most enjoyable outings of the whole year.

The cotton manufacturers of the South have organized an association similar to ours, and I extend to that association the greetings and congratulations of this. It has been suggested by prominent members of both associations that the autumn meetings of both be jointly held at some convenient place. I think the suggestion is a good one; the benefits derived from the Atlanta meeting unquestionably prove this.

Saratoga, Niagara Falls, Philadelphia and Old Point Comfort have been suggested as places for holding the meeting next fall. It is unnecessary to enlarge upon the attractions at Saratoga. No doubt most of you have visited the place; some of you may recollect the place with pleasure, to others it may bring recollections of losses with which they have met there (laughter); but it is said that you should look for your money where you lost it. Niagara Falls presents some unusual objects of interest, just at the present time, in the development of the water and electric power there. Philadelphia, of course you know, is in the centre of manufacturing, with its textile schools, the shipyards, the Baldwin Locomotive Works and other important industries. It seems to me a profitable season could be spent at Philadelphia. At Old Point Comfort you have the historical associations of the place, one of the largest forts in the country, together with attractions at Norfolk across the bay in the way of large coal pockets and shipbuilding. These are all excellent places and I believe it would be a good plan for this meeting to select one of these as the meeting place next year. I am also in favor of having the meeting a joint meeting with the Southern Manufac-

turers' Association, and hope that an invitation will be extended to them.

This place was selected by the Board of Government because they felt somewhat committed to do so, having put it into competition with Atlanta last fall, and I believe no mistake was made in the choice. We may not be able to dispose of our surplus goods here, but we are at least out of sight of them, and while here let us forget them.

It would not, however, surprise me at all to hear that an ex-president of this Association (Mr. GOODALE) was trying to take orders to furnish all the zephyrs that blow up and down these valleys and over these mountains (laughter), or that a prospective president (Mr. KENT) was trying to sell for December and January delivery, some winding sheets of whiteness with which these mountains might be mantled during those months; and I am told that a prominent member, a large blanket manufacturer (Mr. THOMAS) another ex-president, is dreadfully disappointed to find the mountains so beautifully clothed with verdure and leaves — he had been told that that style of dress went out of fashion at the Garden of Eden (laughter).

Never in the history of cotton manufacturing in this country has there been such depression and curtailment of productions as during the past few months, and while we may not be able to solve the national and economic reasons why the cotton manufacturing industry is in its present deplorable condition, we can discuss the papers that have been prepared in anticipation of the time when McKinley Protection and an established Gold Standard shall have opened the mills to profitable manufacturing instead of the mints to free coinage of silver.

Some very valuable and interesting papers have been prepared, and interesting topical questions arranged by an exceedingly efficient committee to whom I am under obligations, and to all who have furnished papers I extend the grateful thanks of the Board of Government. You have no idea how much your willingness to contribute to the success of the meeting is appreciated. I trust that the discussions will be entered into

with spirit, and I wish every member present would take some part, either in the discussions or by asking questions. I wish each individual member would feel it his duty, privilege or pleasure to take part in the meetings. I wish especially that the new members would talk — what is said may or may not become a part of the proceedings at the option of the speaker, and every speaker has an opportunity to correct his remarks before they are published; we are not here to criticize each other but to get and give encouragement and experiences.

A general detailed report of the condition of the Association is made at the annual meeting, therefore I shall not give one at this time, but I will briefly review some of the changes and progress made since two years ago, when the Association jumped the old fences and held the autumn meeting at the Crawford House.

At that time the membership was 292, it is now 459. I wish it could be increased to 2,000, and feel that it should be. Since then the Association has been incorporated under the laws of Massachusetts, giving it a standing financially and otherwise that it did not previously possess.

Complete copies of the by-laws and lists of members have been published, and are in the hands of the members or can be had by them. A permanent office has been established in Boston at 178 Devonshire Street, affording many conveniences to members, where a stenographer is always in attendance, textile papers on file, and the nucleus of a textile library started.

Associate membership has been established which is proving a very valuable adjunct to the Association. This membership numbers 72.

Including the proceedings of the Crawford House meeting and the succeeding meetings, 1,093 pages of printed matter have been published and furnished the members. Since the Crawford House meeting was held the Association has held meetings in Providence, R. I., Atlanta, Ga., and Boston, the Association having travelled as a party over 3,000 miles.

The textile papers and manufacturing directories, recognizing

the growing importance and influence of the Association, gladly give more space and place to this organization and its doings. The associated press request full reports of the meeting.

This increased membership and increased influence brings increased responsibility.

One of the members of the Board of Government has consented to prepare a paper upon the work of the Association, and when it is presented I hope the members will discuss it thoroughly. Give to your officers your views and opinions — the Association belongs to the members, the officers are to execute their wishes — from your criticisms and suggestions let them select the best. (Applause).

"Cotton Manufacturing in Japan," by Hon. ROBERT P. PORTER, Cleveland, Ohio, was read by Mr. A. M. GOODALE in the absence of the author.

SECOND SESSION.

WEDNESDAY, SEPTEMBER 23, 1896, 9.30 A. M.

Meeting called to order, President LOWE in the chair.

The following papers were read:

The Manufacture of Fine Yarns.

HERBERT E. WALMESLEY, Newark, N. J.

Discussed by Messrs. WILLIAM J. KENT, CHRISTOPHER P. BROOKS, LOUIS SIMPSON, STEPHEN A. KNIGHT, RUSSELL W. EATON and WILLIAM G. NICHOLS.

The Use of the Comber in Cotton Manufacture.

E. W. ATKINSON, Boston, Mass.

Topical Question.

73. How fast can a combing machine be run and what production will it make and give satisfactory work?

Discussed by Messrs. LOUIS SIMPSON, ARTHUR H. GULLIVER, CHARLES W. DENNETT, WILLIAM J. KENT and JAMES FIRTH.

Condensed Cotton Yarn and the Condenser Card.

CHRISTOPHER P. BROOKS, Charlotte, N. C.

Discussed by Messrs. WILLIAM G. NICHOLS, JAMES P. TOLMAN and LOUIS SIMPSON.

On motion duly seconded, it was voted that the consideration of Topical Question No. 74, "What is the best tapes or length

of wind for mule cops on number 37 filling?" be postponed until the next meeting.

Topical Question.

75. Can as marketable goods be made from frame yarns as from mule yarns?

Discussed by Messrs. ARTHUR H. GULLIVER, CHARLES H. FISH, STEPHEN A. KNIGHT, WILLIAM J. KENT, LOUIS SIMPSON, THOMAS MAYOR, ARTHUR H. LOWE, CHARLES W. DENNETT, and ARIEL C. THOMAS.

Topical Question.

76. What are the best means to prevent waste of all kinds in a mill?

Discussed by Messrs. WILLIAM J. KENT, STEPHEN A. KNIGHT, ARTHUR H. LOWE, CHARLES W. DENNETT, JOHN S. ADAMS, JR., LOUIS SIMPSON and GEORGE F. WHITTEN.

Differential Motions for Spinning Machines.

JOSEPH NASMITH, Manchester, England.

Topical Question.

77. What are the best methods of allowance for depreciation of mill buildings and machinery?

Discussed by Mr. JAMES R. MACCALL.

THIRD SESSION.

WEDNESDAY, SEPTEMBER 23, 1896, 8 P. M.

Meeting called to order, President LOWE in the chair.

What the Philadelphia Museums can do for the New England Cotton Manufacturers.

WILLIAM P. WILSON, Sc. D., Philadelphia, Pa.

Discussed by Messrs. GEORGE S. BARNUM, ARTHUR H. LOWE, GEORGE OTIS DRAPER, CHARLES T. MAIN, FRANK P. BENNETT, J. PAYSON BRADLEY, D. M. THOMPSON, and ALFRED M. GOODALE.

Mr. CHARLES T. MAIN. Mr. President, I would like to submit the following: "Ordered, That the Secretary be instructed to transmit the thanks of the New England Cotton Manufacturers' Association to Hon. ROBERT P. PORTER of Cleveland, Ohio, Messrs. CHRISTOPHER P. BROOKS of Charlotte, N. C., JOSEPH NASMITH of Manchester, England, and Dr. WILLIAM P. WILSON of Philadelphia, for their papers before the Association, and which have added much to the interest and value of the meeting at the Profile House."

The motion was seconded and carried unanimously.

Mr. ALFRED M. GOODALE. Mr. President, I would like to ask whether the Board of Government have allotted a special time during the session of the Association for the discussion of the place of the next autumn meeting?

The PRESIDENT. I will say in reply that they have not. It was expected that that discussion would come up under the paper which we shall now take up, if it is the wish of the Association to do so — the paper to be presented by Mr. EATON, which would open to discussion on the work of the Association, and under that head they had thought that perhaps the matter of the place of holding the next meeting would be considered.

Mr. GEORGE OTIS DRAPER. Mr. President, will you kindly have the Secretary enter one vote for Philadelphia as the next autumn meeting-place of the Association.

Mr. ALFRED M. GOODALE. Mr. President, Mr. DRAPER'S solitary motion seems a little lonesome, more lonesome than I should like to see it. As Dr. WILSON has done us the honor to bring us a small portion of the Museum, I would move in order to get at the sense of the meeting, that the next autumn meeting of the Association be held in Philadelphia.

The motion was seconded.

The PRESIDENT. It is moved and seconded that the autumn meeting of next year be held in Philadelphia. It would seem to the President that it should simply go to the Board of Government as a suggestion. Something might occur, to make it absolutely impossible or unwise to comply with such a vote.

Mr. ALFRED M. GOODALE. I accept that suggestion, Mr. President.

The PRESIDENT. You understand the motion. (Putting the question.) It is a unanimous vote, and the Board of Government will, of course, consider that as the wish of the members, and act accordingiy, unless something unforeseen should prevent.

Suggestions for Future Work of the Association,

RUSSELL W. EATON, Brunswick, Maine.

Topical Question.

78. Suggestions from each member on the future work of the Association. All members present are requested to be prepared to offer some suggestions.

Discussed by Messrs. ALFRED M. GOODALE, C. J. H. WOODBURY, WILLIAM J. KENT, FRANK P. BENNETT, J. PAYSON BRADLEY, D. M. THOMPSON, S. S. SPENCER, FRANK J. HALE, LOUIS SIMPSON and RUSSELL W. EATON.

A Few Suggestions to Managers and Superintendents.

JOHN S. ADAMS, JR., Adams, Mass.

Discussed by Messrs. GEORGE F. MORGAN and STEPHEN A. KNIGHT.

FOURTH SESSION.

THURSDAY, SEPTEMBER 24, 1896, 9.30 A. M.

Meeting called to order, President LOWE in the chair.

Looms and Loom Fixers; Weavers and Weaving Rooms.
ALFRED HAWKESWORTH, Montreal, P. Q.

Discussed by Messrs. GEORGE OTIS DRAPER, ARTHUR H. GULLIVER, FRANK P. BENNETT, WILLIAM J. KENT, LOUIS SIMPSON, C. J. H. WOODBURY and GEORGE F. MORGAN.

Topical Question.

79. What is the best way to pay section hands in a weaving room where plain twill, fancy sateen, lappett and Jacquard looms are to be run?

Discussed by Messrs. ALFRED HAWKESWORTH, GEORGE F. MORGAN and GEORGE E. SPOFFORD.

Topical Question.

80. What is the best temperature and humidity in cotton mills where fine and coarse goods are to be woven?

Discussed by Messrs. ALFRED HAWKESWORTH, JOHN ECCLES and RUSSELL W. EATON.

Power Required to Drive Gingham Looms.
GEORGE W. WEEKS, Clinton, Mass.

Discussed by Messrs. LOUIS SIMPSON and ROCIUS C. NEWELL.

Mr. D. M. THOMPSON. Mr. President, I would like to offer a few words in the form of a preamble and resolutions touching the matter presented here by Dr. WILSON last evening:

Whereas: The Board of Government, after careful investigation of the Philadelphia Museums decided that it was an institution worthy of approval and nominated a vice-president of this Association on the Advisory Board, and

Whereas: This Association having listened with deep interest to a clear and able presentation of the purposes, policy and work of the Philadelphia Museums, particularly in regard to the development of foreign commerce in American textiles, and further in regard to the broad scope of its work intended to promote and advance American interests upon all lines of industrial work, therefore, be it

Resolved: That the New England Cotton Manufacturers' Association hereby express its earnest approval and endorsement of the very important work, and further desires to call the attention of the representatives of all American industries to the invaluable services of the liberal public spirited citizens who have wisely conceived and organized the great work of the Philadelphia Museums, and to the liberal support of the city of Philadelphia, of an enterprise entitled to pre-eminent rank as a great national interest, worthy of the highest commendation and encouragement; and be it

Resolved: That the President and Board of Government are hereby requested to adopt such further measures as in their judgment may seem desirable to properly present to the management of the Philadelphia Museums the assurance of the earnest support of the Association.

And I would further suggest in this connection that there should be entered upon the minutes of this meeting a vote of thanks to Dr. WILSON for his very able presentation. I regard it as one of the most interesting works that has ever come before the Association and destined to have a vast and wide influence on all interests — not alone our own, but all others.

Mr. D. M. THOMPSON. Mr. President, I have waited in the hope that further remarks would be made, in evidence of the deep interest of this Association and its high appreciation

of the work proposed by the " Philadelphia Museums," so ably presented by Dr. WILSON.

The impulse which prompts me to speak is in a measure due to a circumstance, the full importance of which I recognize this evening for the first time. I have recently been advised by the Providence Board of Trade, of my appointment as a member of the Advisory Board of the " Philadelphia Museums." I have not realized the extent of the honor until this evening while listening to the vivid description, accompanied by the graphic illustration, which so clearly exhibits this remarkable project.

The character and scope of its work suggests to my mind the possibilities of marvelous results. I can simply say that my interest is moved to a degree I cannot well express, and I shall take pleasure in rendering such personal service or influence as may be at my command.

It is proposed to collect samples of the raw materials of all countries, and the products of labor in all industries from foreign countries, to be classified, indexed for ready reference, and each sample tagged with description and information, such as its origin, where and by whom produced, its cost, wholesale and retail price and the market for its distribution. Think for a moment what this grand institution and its work means to the cotton industry alone. Upon the tables before us are eight thousand samples of foreign textile products of recent date, all collected during the past six months. These products, we are informed, were nearly all designed with especial reference to South American markets, and embrace only about one-sixth of the total collections which have thus far been made in this single department. This information, as applied to the almost infinite diversity of American industries, is of incalculable value.

The " Philadelphia Museum " has been in operation less than three years. It was organized and started upon its wonderful mission through the agency of a few public-spirited and liberal citizens of Philadelphia. It has received valuable assistance from the Pennsylvania Railroad, and the city of Philadelphia has thus far contributed for its support appropriations amounting to

three hundred thousand dollars. The vast collections assembled at such cost, are announced as free and open to the inspection of all persons and interests. In addition to this, special privileges are granted to individuals or corporations, upon the payment of the nominal sum of fifty dollars per annum. This will secure to the subscriber prompt and full reports touching any question of information relating to his interest—material matter of great importance, and impossible otherwise to obtain.

The character of this enterprise, so grand in its conception, so full of the wisdom of a great, liberal-hearted philanthropy, and distinctively local in its support, very naturally suggests the inquiry of my friend (Mr. WM. J. KENT) as to where the interests of Philadelphia come in, that she can make such liberal contributions and then give to the world, free, the results of all this labor.

Mr. President and gentlemen, I suggest in reply that benefactions such as this never fail to return most ample rewards to the benefactors. To just such effort and enterprise as this, applied to all lines of scientific investigations and industrial art, are we indebted for our present civilization. Recall the past, only for the brief period of one hundred and forty years, with its early and continuous struggles, its marvelous progress, slowly at first, but with a constantly forward movement, steadily overcoming the inertia of narrow prejudice and the individualism of earlier times, until the concentration of effort and more liberal views, have finally united men in the close touch which we seek to promote in this association, representing the vast interests of the cotton manufacture of the United States of America.

Go back to 1756-57. Note the history of the Society of Arts in London; trace its influence. Seven years later WATTS entered upon his remarkable career, followed shortly thereafter by HARGRAVES, ARKWRIGHT, KAYE, WILSON and GEORGE STEPHENSON; also the organizations designed for the purpose of exhibiting the products of industry, at first simple and local, gradually extending to include larger areas, of burroughs, counties, states and individual nations.

Mark the progress which had obtained and note the conditions existing in 1849 — only forty-five years since — when Mr. BUFFITT, Minister of Agriculture of France, addressed circular letters to the various Chambers of Commerce, for the purpose of ascertaining the views of manufacturers on the question of admitting specimens of the products of industry from neighboring countries at a then approaching exhibition. The replies received were so unfavorable that the minister was induced to at once abandon the idea. So exclusive were the French at this time, that a proposal to admit a representation of foreign products, was deemed to have emanated from the enemies of French industry.

Two years later, in 1851, the first international exhibition was held in London. The influence of this and subsequent expositions, have been the chief factors in the wonderful and marvelous progress of modern civilization.

The great achievements of the past have justified the expenditure of the hundreds of millions, but the end is not yet. The same effort and spirit of enterprise must be continued — it is inevitable. The sharp competition of modern business demand the employment of all honorable means in its promotion. Human effort upon all lines must meet the "struggle for existence" with the knowledge that it is a "survival of the fittest." To this end individuals, communities and nations, as never before, are employing every influence and energy they possess to advance their interests into stronger and more commanding positions.

It is precisely upon these general lines that we may regard the important work which is proposed by the "Philadelphia Museums." The history of industrial progress, or the exhibitions of the products of industry, fail to exhibit a more worthy and commendable object, than appears in the prospectus of this grand and munificent enterprise, whose propositions I believe are eminently practical and full of promise for the future.

Philadelphia is entitled to the gratitude of the country. This Museum is an enterprise destined to rank among the greatest of her achievements, a monument worthy of her great liberality,

and a permanent memorial to the wisdom and sagacity of her many public-spirited citizens. The "Philadelphia Museum" is in the highest sense national in its purpose and benefits, and should receive national support. I believe its work, if properly sustained and extended upon the lines proposed, will mark an epoch in the progress and development of American industry. It will embrace all classes and conditions of labor. It is an agency which gives promise of the early acquisition of valuable foreign markets for American products and the extension of trade and commerce. It will prove a factor of great power in advancing our domestic interests upon all lines of useful work.

For these and many other reasons, I trust that our President and Board of Government will be requested to devise such measures as they may deem expedient, to insure the hearty support and co-operation of this association, and all others within its influence, in behalf of the "Philadelphia Museums," to the end that its grand purposes may be achieved in the interest of our common country.

The PRESIDENT. I will say that the President is very glad to have this matter take this form. A vote of thanks was extended to Dr. WILSON last night, if you remember. However, the President takes great pleasure in saying a word in endorsement of this great scheme. It seems to me that it is one of the most interesting, one of the most important matters, that has been brought before our Association, and I am very glad that this resolution of endorsement has been prepared. I understand that the resolution is moved and seconded, and if you are ready for the question I will put the motion.

The resolution was adopted unanimously.

Practical Theory on Steam Making from Shovel to Stop Valve.

WINTHROP THAYER, Boston, Mass.

The Heath Metallic Bale.

JOSEPH H. KENDRICK, Providence, R. I.

Power Transmission.

FRANK H. UNDERWOOD, Boston, Mass.

Economical Arrangements for Transportation of Cotton from Storehouse to Pickers; and of Cloth from Weave Rooms to Cloth Hall.

EDWARD W. THOMAS, Lowell, Mass.

The PRESIDENT. Representing the Board of Government I want to thank all the members who have furnished papers or who have taken part in the proceedings. It seems to me that we have had a very pleasant, interesting and profitable meeting. The programme which has been arranged by the Board of Government has been completed, and unless some member has something to propose, a motion to adjourn will be in order.

Mr. FRANK P. SHELDON. Mr. President, I move we adjourn, *sine die.*

The motion was seconded and carried.

Adjourned.

C. J. H. WOODBURY,

Secretary.

TRANSACTIONS.

FIRST SESSION.

TUESDAY, SEPTEMBER 22, 1896, 8 P. M.

The Association met in the parlor of the Profile House, President LOWE in the chair.

The PRESIDENT. We had expected this evening to have with us Hon. ROBERT P. PORTER of Cleveland, to read a paper upon what he had seen in his recent travels in Japan in reference to cotton manufacture. But next to having the writer of the paper present with us is having with us an ex-president of the Association who is willing to read the paper, which he will do, and I gladly introduce to you Mr. GOODALE. (Applause.)

Mr. ALFRED M. GOODALE. Mr. President, ladies and gentlemen, I will state that this paper has been received since our arrival and that I have not had an opportunity to familiarize myself with it; and further, that there are a great many Japanese names in it which I shall have to slur over — I simply cannot pronounce them.

Mr. GOODALE read the following paper:

COTTON MANUFACTURING IN JAPAN.

HON. ROBERT P. PORTER, Cleveland, Ohio.

I feel an apology is necessary from one so little versed in the technicalities of cotton manufacture for venturing to address the New England Cotton Manufacturers' Association upon a subject of such vital consequence to the future of cotton spinning as the topic assigned me. I have undertaken to do so with brief consideration, in response to a polite letter from your President, requesting my views on cotton manufacturing in Japan. It is with some timidity that I approach the subject, hoping the members of the Association will bear in mind that the close observations of a journalist, statistician though he may be, and accustomed to dealing with all sorts of data, will fall far short of giving you the information that an expert from your own industry could convey.

The cotton spinning and manufacturing industries of Japan should be studied in connection with the same industries in India and China. The debatable question at the present time I find to be, Is the future situs of the cotton spinning industry to be China or Japan? Certainly both countries are making progress, and at this stage of the game it is difficult to make a forecast as to the future. We know that the Japanese began the spinning of cotton by European machinery about sixteen years ago, and I was told that the oldest mill in Osaka dated back only thirteen years, the average age of existing mills not being over, say, five years. In this time the grand result has been the substitution of factory for homespun yarn for domestic purposes. The next step will be for Japan to compete with imported yarn. Between 1867 and 1877, cotton yarn represented 35 per cent. of all the importations into Japan. This I

have no doubt led to the government purchasing cotton machinery of England, and by giving private corporations easy terms of payment, resulted in firmly establishing the industry. Cotton spinning alone now gives employment to over 10,000 men and over 30,000 women, and by the end of this year the number will be considerably augmented.

While it may be a trifle out of order to introduce the yarn tables of imports before the raw cotton, it will emphasize our point more to show the material reduction in the importation of yarn into Japan from India since 1890. Here is the table:

Year.	England.	India.	Other Countries.
1890.	Kin.	Kin.	Kin.*
Amount,	17,911,109	13,970,023	
Price,	$6,374,282	$3,542,529	
1891.			
Amount,	12,787,408	4,548,045	2,138
Price,	$4,453,112	$1,135,459	$719
1892.			
Amount,	16,048,337	8,258,369	1,785
Price,	$5,316,682	$1,814,394	$904
1893,			
Amount,	14,527,812	4,865,040	12,300
Price,	$6,033,005	$1,243,163	$8,075
1894.			
Amount,	13,606,172	2,333,625	3,000
Price,	$7,288,690	$687,556	$1,210
1895.			
Amount,	13,247,316	1,341,691	2,076
Price,	$6,688,066	$392,631	$2,277

*1 1-3 pounds.

NOTE.—The dollars in this table are silver.

Going still further back, I find that in 1887 the quantity of cotton yarn imported into Japan was 47,439,693 *kin*, but the import was reduced to about 14,500,000 *kin* in 1895; and this year it will be about 12,500,000 *kin*. The low count yarn manufactured in Japan — under 20s — has prevented the import of Indian cotton yarn. The quantity of Indian yarn received during 1890 amounted to 13,970,000 *kin*, but it was greatly reduced in 1895, the total quantity received during that year being 1,341,691 *kin*. These figures show that Japan has already at-

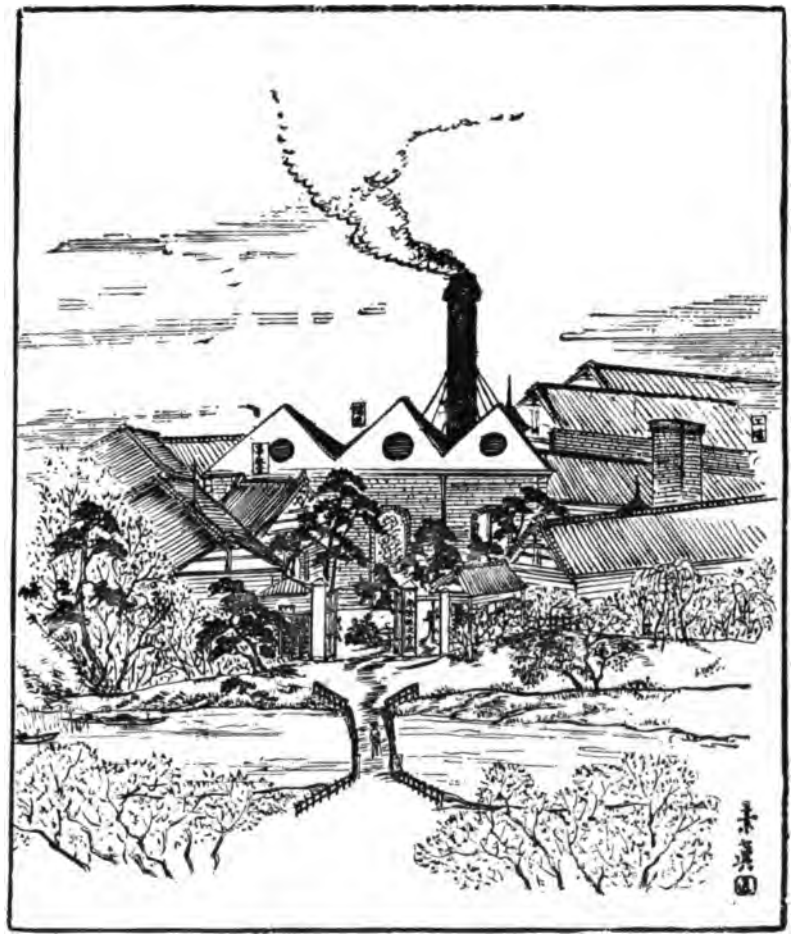

FIG. 1.—VIEW OF THE MILL AT KANEGAFUCHI.

tained the desired result in the matter of competition, and that she has succeeded to a large extent in competing with the imported article, but there still remains the work of stopping the import of considerable Indian cotton yarn. This can be done by increasing the manufacture of low count yarn on the one side, and on the other in competing with the English yarn by manufacturing fine counts. The import of English yarn of finer counts, from 30s upwards, does not show any remarkable change, though in the low counts — in which a much larger business is done—Indian yarn has been beaten by the Japanese yarn.

The Japanese are perhaps prouder of the cotton spinning industry than of any other, and this is because it is a purely European industry transplanted to that country and carried on wholly by Japanese labor. In a recent address the Vice-Minister of Agriculture of Japan, Mr. KANEKO, refers to this fact in the following language:

"Strictly speaking, the cotton spinning machinery is European machinery introduced into this country, and the cotton spinning industry is an European industry started in Japan. Cotton yarn is the first merchandise manufactured in this country by machinery after European style to be exported abroad. I should think that no other industry offers such promising results as the cotton spinning industry. As the people are now earnest to a degree concerning the export trade, the government authorities should give an impetus to the development of such a well paying industry, and the people on their side should work zealously to maintain its growth. I hope that cotton yarn will become one of our important products in the markets of the East in future."

In this same address, delivered July, 1896, before the Oriental Society, Mr. KANEKO declared that 60 per cent. of the whole consumption of cotton yarn during 1894 in Korea, was supplied from Japan. For the same period China imported cotton yarn valued at $31,522,583 (silver), of which Japan shipped nearly a million dollars' worth, or less than 3 per cent. Of course, this is a small proportion of the whole consumption, but it is a start, and when once Japan starts in a given branch of trade its prog-

ress is very rapid. A very large proportion of the cotton yarn imported into Hongkong, say at least 90 per cent., comes from India. Japan is practically sending nothing to Hongkong at present. But she will. Mr. KANEKO is very hopeful and evidently thinks that in the near future Japan will be able to wrest the bulk of the yarn trade from India and England. In the address referred to he says, after calling attention to the actual figures:

"We have then the chance of supplying 37 per cent. more to Korea, 98 per cent. more to China, and even far greater quantities to Hongkong. It will be seen that there are immense opportunities left open to us in supplying cotton yarn in competition with India and England. Turning to the market in Australia, we have much still to do. During 1894, Australia imported cotton yarn to a total value of $22,837,020 (silver). Should the demand for our cotton yarn extend in that country, the spinning industry of Japan would advance by leaps and bounds, even if the demand from Korea, China and Hongkong were lost. But I shall not dwell upon this point at present."

The tendency in Japan for the next ten years is from coarse to fine yarns. This will help American cotton. Note what Mr. KANEKO, already quoted from, says on this point:

"It is natural that things should develop from coarse to fine. Formerly the people were accustomed to wear cotton cloth made with very coarse yarn, but of late cotton cloth of very fine thread has become popular. This explains why so large a quantity of fine yarn is being imported from England. In making fine counts, like the English yarn, the raw cotton produced in the United States is required, China and India cottons not being fit for the purpose owing to coarseness of fiber. Accordingly, we feel the necessity of providing ourselves with ready means to import American cotton, in connection with which special banking facilities will be required. In order to accomplish these things the co-operation of government and people is very important. It is also a very important question to decide how many spindles are required in this country to ensure a full supply of cotton yarn."

The importation of cotton from the United States is increasing

very rapidly and is fully double what it was in 1893. The Japanese manufacturers are not only willing to use our cotton, but actually need it in much larger quantities than it has heretofore been received. Taken in connection with the decrease in the importation of cotton yarn, the corresponding increase in the importation of raw cotton is readily explained. The extent of this increase during the past eight years is shown by the following table:

Year.	Importation of Raw Cotton.		Importation of Cotton Yarn.	
	*Kin.	Silver.	Kin.	Silver.
1888,	11,893,267	$1,652,143	47,439,639	$13,611,898
1889,	23,168,094	3,464,326	42,810,902	12,522,039
1890,	26,084,345	4,134,790	31,908,302	9,928,061
1891,	50,128,750	6,998,533	17,337,600	5,589,289
1892,	78,647,573	11,026,637	24,308,491	7,131,979
1893,	93,835,718	15,294,897	19,405,152	7,284,242
1894,	108,415,609	19,103,922	15,942,797	7,977,365
1895,	143,468,259	24,304,814	14,591,083	7,082,975

*Kin is 1 1-3 pounds.

How the purchase of the cotton of 1895 was distributed and the aggregate price paid is shown by the following table:

	Amount, Kin.	Value, Silver.
From British India,	46,683,887	$7,693,224
China,	82,171,626	13,786,101
French India,	2,301,338	406,816
Siam,	61,718	9,187
United States,	11,996,115	2,338,177
Other Countries,	253,575	71,307
Total,	143,468,259	$24,304,812

It will be seen that of the raw cotton imported in 1895 over one-half came from China, nearly one-third from British India, and about one-twelfth from the United States.

The report of the Cotton Spinners' Union for the month of May, 1896, showed that there were in the kingdom 67 mills with 607,505 straight spindles, 86,404 slanting spindles, and an

addition of 453,136 spindles soon to be put in operation, making an aggregate of 1,147,045 spindles. The rapid growth of the industry is well illustrated by the fact that the report issued by the Cotton Spinners' Union at the close of the year 1894 showed only 59 mills in operation with 523,696 spindles.

In these factories the maximum hours of labor are 24, the minimum 12, with an average of 22½ hours. The straight spindles produce an average of .88 pounds of yarn per spindle per day, while the slanting spindles average .6 pounds per spindle per day. The number of male operatives in the factories range from 13 to 1,087, the total being 10,531. The female operatives range in number from 31 in the smallest factory to 3,732 in the largest, the total number being 33,452.

The horse power of the machinery in operation aggregates 15,595, the average consumption of coal per horse power being 3.498 pounds per hour. Very few American machines are to be found in the cotton mills of Japan. Nearly all of those now in use are of English manufacture, a considerable portion having been supplied by the firm of Platt Brothers & Co., Ltd., of Oldham. The almost exclusive use of the English machines is generally attributed to the fact that the Japanese regard England's textile industries as the most flourishing extant, and to the further circumstance that the English originally introduced the industry into Japan. The operatives have also gotten accustomed to these machines and the mill owners hesitate to make a change.

That the cotton spinning industry has proven profitable may readily be imagined when it is stated that so far this year six new companies have been formed whose projects contemplate the operation of 101,083 spindles. Persons in a position to know declare that before the close of the year 1897 there will be fully 1,500,000 spindles in operation in Japan. The average net profit per spindle during the first six months of last year was $2.97 (silver), but it increased to $3.78 (silver) during the latter half of the year. The greatest profit per spindle was $6.76 (silver) while the least was 38 cents. The spindles in

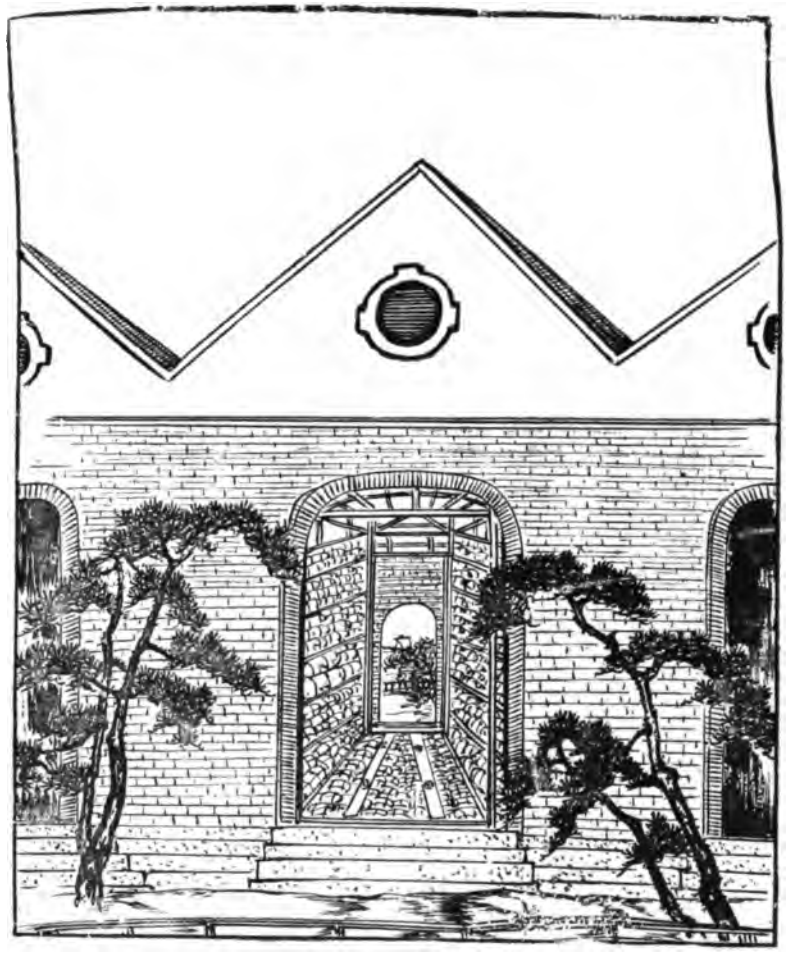

FIG. 2.—COTTON STOREHOUSE.

operation last year consumed 15,016,633 pounds of raw cotton and turned out 12,718,750 pounds of yarn. The average price of the yarn was about $93.45 (silver) per bale of 400 pounds. The following table shows the profit per spindle realized at the various mills during the year 1895:

Name of Cotton Mill.	Profit per Spindle First Half of 1895. Silver.	Name of Cotton Mill.	Profit per Spindle Second Half of 1895. Silver.
Koriyama	$4.661	Koriyama	$6.761
Kishiwada	4.627	Himeji	5.388
Owari	3.860	Kishiwada	5.255
Sakai	3.802	Owari	4.808
Settsu	3.760	Sakai	4.751
Hirano	3.741	Wakayama	4.629
Kurume	3.630	Uwajima	4.453
Wakayama	3.602	Settsu	4.395
Fukuyama	3.521	Hirano	4.388
Kurashiki	3.440	Iyo	4.257
Osaka	3.130	Miye	3.984
Kanegasuchi	3.220	Fukuyama	3.936
Meiji	3.170	Amagusaki	3.746
Miike	3.121	Meiji	3.555
Uwajima	3.093	Kanegafuchi	3.432
Amagusaki	2.852	Osaka	3.403
Matsuyama	2.840	Tokyo	3.393
Miye	2.684	Kurashiki	3.233
Senshiu	2.537	Fukushima	3.032
Asahi	1.826	Senshiu	2.985
Tamashima	1.725	Miike	2.691
Himeji	1.725	Okayma	2.507
Fukushima	1.484	Tamashima	2.206
Tokyo	1.433	Asahi	2.052
Iyo	.706	Noda	1.453
Average profit for first half of 1895,	$2.975	Average profit for second half of 1895,	$3.779

In a conversation a few weeks ago with Governor CHARLES W. LIPPITT of Rhode Island, a representative mill man of New England, he said you would all be very happy indeed here in New England with such profits as these.

The wages of cotton spinners in the mills throughout the

empire are of course low. Probably the highest are received by the operatives in the Tokyo mills, where the average for men is as high as 23 *sen* per day, or, at the present rate of exchange, say 13 cents per day; for women 11.8 *sen*, or about 6½ cents United States money. There are mills, however, even in this district where the pay is as low as 8 cents for men and less than 5 cents per day for women.

The women operatives outnumber the men many times and consequently their wages should be considered first. The factory girls differ considerably in age, ranging from 12 to 30 years, the younger girls being employed in the fine spinning rooms. A corresponding difference is found in their wages, the rates ranging from 2½ cents per day for day girls and 4 cents for girls living at the boarding house within the mill, to $10 (silver) per month. Many of the employes are also paid by a system similar to the piece work method of this country. For rough spinning about 3 cents per hank is allowed, and skilled girls can turn out from 7 to 9 hanks per day. For reeling, the pay per spool is about three-tenths of a cent, and the girls, when they have become expert at the work, can reel as high as 50 spools per day. The maximum wage for girls in the fine spinning department is abont 7 or 8 cents, but this is considered very fair compensation considering the fact that most of the employees are only 14 or 15 years of age. In some of the mills there is a system of prizes for faithful service, in others an increase is given three or four times each year, while in other manufactories what is known as an "extra," amounting to about 10 cents, is given to the most industrious workers semi-annually. In still other mills there are prizes for uninterrupted work; 10 cents for one month, 20 cents for three months, 65 cents for six months. For those who renew their contract of service after the articled time of three years, prizes are almost doubled. Moreover, girls who are not absent from their work during a period of three years, receive a special prize of $15 (silver); those who make a similar record during five years receive $25 (silver); and those who are correspondingly faithful for seven

FIG. 3. — SHIPPING GOODS.

years receive $35 (silver). All these emoluments are of course over and above the regular rates of wages given above." The girls are encouraged to thrift as well as to industry, and in many of the mills both voluntary and compulsory systems of savings are in force. On these deposits, of whichever character, 10 per cent. interest is paid, although if a girl leaves the factory before the expiration of the term of three years for which she enters, her compulsory savings are forfeited by the firm.

Some idea of the thrift of the girls may be gained from the fact that many of those who receive $10 (silver) remit as much as $7 or $8 per month to their parents at home. Often girls upon the expiration of their three years' service have accumulated $70 or $80 (silver) in addition to considerable clothing purchased while they were employed at the factory.

The girls employed at the mills almost invariably live in the boarding houses connected therewith, where they are charged at the rate of 1 cent per meal or 3 cents per day. The youngest employees who have just entered upon a three years' term of service, when they live at home receive only 2½ cents per day, but if they agree to lodge and board at the factory, they are allowed 4 cents, and as the meals provided there for 3 cents are much superior to those afforded in most of the homes of the poorer classes, the latter plan is almost always adopted by the employees. The meals served in the factory boarding houses are by them considered substantial. Breakfast consists of boiled rice and a few slices of pickled radish or sometimes rice and bean soup; the menu at dinner includes rice and vegetables, and supper, which is the heartiest meal of the day, consists of rice and fish. On holidays special lunches are provided.

The employees in each factory have a distinctive uniform, which is purchased by each employe for about $3 (silver), which is usually paid in four or five monthly installments. Everything else required, such as shoes, umbrellas and bed clothing, is furnished by the mill, and thus in view of the fact that a girl's total monthly expenses need not exceed $2 (silver), the amount of their savings does not seem strange.

The proprietors of the mills in Tokyo have recently undertaken to make some provision for the education of their employees, and at the conclusion of their regular work the girls devote two or three hours daily to the study of reading and writing and instruction in sewing. The studies usually include also a smattering of the English language and almost all the older girls can spell the different technical terms used in connection with the machinery at the mills.

The girls are divided into night-workers and day-workers, and 12 is the usual number of working hours, although when the time for lunch is deducted, the actual working hours rarely exceed 11. However, when the mill is crowded with orders, the girls are perfectly willing to work about six hours extra each day, and instead of complaining seem glad of the opportunity. For this additional work they are paid 4 cents extra. The girls are allowed five or six holidays at various seasons of the year, and also a week at the beginning of the new year. They also secure several hours' rest each week, during the time regularly apportioned for the repair of the machinery.

The character of the work does not appear to prove the excessive strain on the employees that might be expected, and the girls who work uninterruptedly for one, two or even three years are to all appearances not impaired in health in the slighest degree. The sick rate is very low, there being, for instance, in the Kanegafuchi mill, where 1,700 girls are employed, a daily average of only four or five cases of sickness. A regular physician is on duty at each manufactory, and girls who are sick are allowed one-half of the lowest wage rate obtained in the factory, usually 4½ cents per day, while in case of suffering from an injury received whilst in the discharge of duty, such as might result from the breakage of machinery, the full amount of the wages is allowed until recovery, and usually a certain amount as a "consolation gift" upon resumption of work. The maximum charge for medicine is 1½ cents per day, and when in the case of protracted illness a large bill accrues, the girl is allowed to pay it on the instalment plan. In case the factory physician

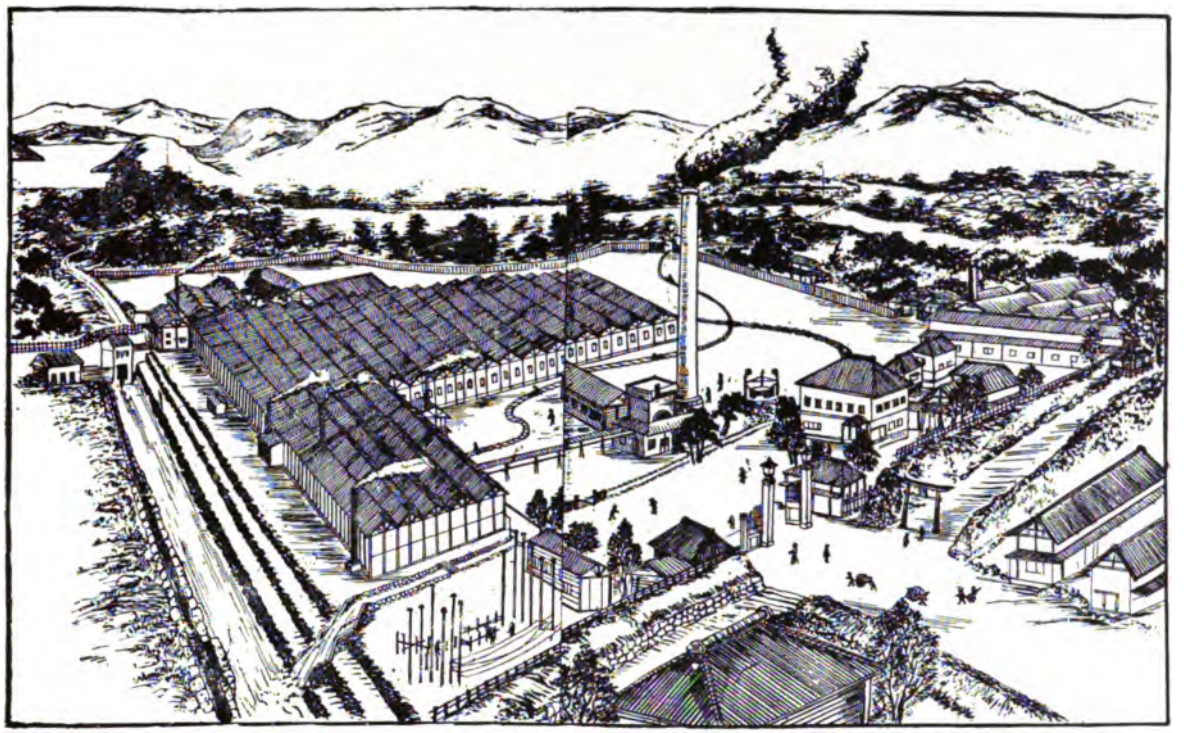

FIG. 4. — JAPANESE COTTON MILL.

declares a case incurable, the mill defrays all expenses the girl may have incurred for medical attendance, and also pays her traveling expenses to her home. In some cases this has necessitated an expenditure of amounts as high as $20 (silver). In many mills the operatives have relief societies, to which, in the case of the larger mills, the officers and employees will contribute as much as $250 (silver) every six months. The majority of cases of sickness consist of some form of lung trouble.

In engaging operatives the firm owning the factory, as a rule, advance to each a sum sufficient for traveling expenses, the amount to be refunded within two years. When a girl has completed a term of service of three years, her employer usually presents her, as a parting present, with a sum sufficient to meet one-half the expense of returning to her home. The great majority of the girls are engaged through the medium of agents to whom each girl makes a cash payment of 10 cents, followed by instalment payments of 1 cent per month, during the term of her employment. The latter charge is made for the agent's services as guarantor for the girls. The employers are highly pleased to have some one of responsibility as security and they naturally prefer to secure employees through the agents.

The great activity of the various industries in the interior has recently resulted in a very perceptible scarcity of employees. This possibly accounts for the presence of so many older employees in the mills. There are in the Tokyo mills several employees who have been in the service of their present employers for twenty years, and who maintain a household and even support a husband upon their salary of $10 (silver) per month.

The men employed in the cotton mills are decidedly in the minority, and receive from 7½ to 15 cents per day. The great fault to be found with the system of operation of the cotton mills is in the seven days' work each week and the prolonged hours of labor. Some idea of this is given by a tabulation of the hours of labor in some of the factories of Osaka, in which city upward of 23,000 operatives are engaged in the industry. The table is as follows:

Age.	Number of Operatives.	Average Number of Hours.
Above 60,	56	11 hours, 7 minutes.
" 20,	7,385	11 " 15 "
" 15,	5,743	11 "
" 12,	2,518	11 "
" 10,	573	11 " 10 "
Below 10,	171	11 " 15 "

One of the most interesting features of the industry is to be found in connection with the exportation of the product. Among the cotton fabrics exported are: white cotton piece goods, corrugated piece goods, black-dyed piece goods, cotton flannel, towels, shirtings, etc. Of the above, white piece goods, black piece goods, and cotton cloths called futa-ko fabrics, are chiefly manufactured in the Yama and Owau provinces and in the city of Huneji; cotton corrugated goods chiefly come from Ashikaga and Seno counties, Awa province, Tokyo and Yamaguchi districts; towels from Koke and Osaka; cotton flannels from the Izumi, Kawachi, Kyoto, Iyo and Awa districts; chjora cloths from Tokyo, Osaka and Yamashira, and cotton shirtings from Osaka, Tokyo and Wakayama. The corrugated goods and cotton flannels are exported in much larger quantities than the remainder, there having so far as 1896 been $1,067,573 (silver) worth of the former exported, as against $586,970 of the latter. The majority of all exports went to China.

So far this year Kyoto has exported to the United States $130,000 (silver) worth of cotton goods, principally white cotton piece goods stamped with figures and intended for use in the manufacture of screens.

Yamato was formerly famous for its white cotton piece goods, but the importation of white shirtings considerably affected the industry, which has, however, since machine yarns were introduced, revived very perceptibly. All kinds of dyed fabrics are also produced in this province. The total output in 1894 was 3,105,967 pieces, valued at $1,093,773 (silver).

Ehime, noted for its cheap corrugated piece goods, had in 1894 a total production of 4,242,078 pieces, valued at $847,805

(silver). Last year Japan produced 1,520,738 pieces of cotton cloth valued at $4,935,435 (silver).

The production of corrugated cotton goods in 1894 aggregated 1,401.120 pieces, valued at $854,031 (silver).

The annual production of white cotton piece goods aggregated 23,874,575 pieces, valued at $6,161,004 (silver).

The total product of futa-ko cotton fabric products aggregated 1,928,159 pieces, worth $1,388,105 (silver).

In connection with the production and exportation of manufactured cotton goods, interest attaches to the exportation from Japan of cotton yarns as shown in the following table:

COTTON YARN.

COUNTRIES.	1893.		1894.		1895.	
	AMOUNT.	VALUE.	AMOUNT.	VALUE.	AMOUNT.	VALUE.
	Catties.	Silver.	Catties.	Silver.	Catties.	Silver.
China	265,117	$48,491	3,270,560	$876,805	2,419,760	$683,087
Korea	26,962	6,302	231,733	68,693	1,081,942	343,578
Hongkong	23,914	4,382	35,700	9,811	30,502	7,620
Other Countries			875	220	689	193
Totals,	315,993	$59,175	3,538,868	$955,529	3,532,893	$1,034,478

Cattie equals 1 1-3 pounds.

FIG. 5.—TYPICAL MILL OPERATIVES.

Here we have another illustration of the rapid increase in the exportation of a Japanese commodity. These figures should be taken in connection with what the Vice-President of Agriculture said about the possibilities of Japan furnishing cotton yarn not only for China and Korea but for India.

It is claimed by some persons that the remarkable fluctuations observable in a comparison of the exports during the different years given in the table, are attributable to the Shimonoseki Treaty, which has secured to foreigners the right to establish factories in China, and which it is claimed has seriously affected the Chinese market for Japanese yarn. For additional facts in relation to exports and imports of cotton and cotton goods, see table accompaning this address.

This brings us to the subject of Chinese competition in the cotton industry, the most vital question now claiming the attention of the Japanese cotton spinners. The advocates of Shanghai as a site for spinning factories argue that factories in Japan have no prospect of being able to compete in the Chinese market, because of the fact that the Shanghai factories will have always at hand an abundant supply of raw material, which the Japanese have to procure from abroad, and will be free from the burdens of freight, marine insurance and duty—duty which would have to be paid twice, once on the export of the raw material from China and again on the import of the yarn into China. They assert that the Shanghai manufacturers can also command an even more abundant supply of labor at least as cheap as the cheapest in Japan, inferior to the latter in intelligence, but superior in strength, docility, faith in observing agreements, and perhaps in endurance. It would naturally be imprudent for me to tread very heavily on this question of Shanghai competition, because I only know what I have been told about it, and most of my information comes from Japanese sources. That the industry is flourishing there is shown by the following extract from the latest report (1895) of Mr. GEORGE JAMISON, British Consul to Shanghai:

"I have in previous reports traced the development of the cotton spinning industry at Shanghai. This year witnesses a new departure altogether. It is no longer a question of a few mandarin-owned mills, but the whole industry has by the Japanese treaty been thrown open to the capital of the world. Some questions, and these no doubt of great importance, have yet to be settled as to the taxation which the Chinese authorities may impose both on the produce of the mills and on the raw material required for their use. But I do not doubt that these questions will soon be settled in a just and equitable manner, having regard to the various interests involved. A fair compromise would point to an excise duty equivalent to the import duty, and treaty privileges as to transit dues.

"At the close of the year 105,000 spindles were in operation, and 30,000 were in the course of being erected. These belong to the original Chinese administration, or the mills affiliated with them. In addition, four foreign companies have been floated during the year, and buildings are now under construction which will contain, in round numbers, 145,000 spindles. Several other companies are in the air, among them two Japanese, but they seem to be holding back pending the settlement of the taxation question, and probably also to see what success attends the new ventures. The Chinese companies, of course, publish no accounts, but report credits them with very handsome profits. At all events they have been running night and day all the year round, with every sign of prosperity."

The Japanese interested in the various branches come back with some very powerful arguments. They state that it is a singular fact that there should be cited as the chief inducement for the establishment of mills in Shanghai the supposed accessibility of Chinese raw cotton, without taking any notice whatever of the impediments which may be encountered in every direction. They say that the accessibility of raw material at non-prohibitive rates depends entirely on the good will of the Chinese local officials. On cotton for export — in other words for the use of Japan — their exactions in the form of transit duties are limited by convention, but on cotton carried to Shanghai, to be used there for the manufacture of goods intended for sale in China, they may impose whatever rates of *lekin* they choose. It is said that this evident danger has even induced the projectors

FIG. 6. — SPINNING COTTON BY HAND.

of certain cotton mills in Shanghai to abandon the project after land and machinery had been purchased.

The Japanese assert that raw cotton purchased in the interior of China and transported to Shanghai may be put on board ship after paying an export duty amounting to about 3 per cent. *ad valorem*, together with commuted *lekin* amounting to 1½ per cent., a total of 4½ per cent. After adding to this the cost of carriage to Japan, the total would not exceed 12 per cent. This would constitute the price which Japanese mill owners would be obliged to pay plus, of course, the original cost. The Japanese claim, on the other hand, that the cotton intended, not for shipment abroad, but for manufacture in Shanghai and sale locally, cannot have the privilege of commuted *lekin*, and the mill owner in Shanghai would be likely to find the original cost of the cotton enhanced by taxes aggregating from 20 to 40 per cent., in lieu of the 12 per cent. which would suffice to bring the cotton to Japan.

This peculiar condition of affairs is due to the fact that England, in answer to the protests of her merchants, who claimed that excessive collections of *lekin* were being made, concluded a convention at Chefoo in 1876, and which was ratified in 1886, which provided, among other things, that articles carried from the interior to an open port, if *bona fide* intended for shipment abroad, and if certified in that sense by a British merchant, might secure exemption from all taxes in transit by the payment of a commuted impost equal to half of the export duty.

It is claimed by some of the advocates of the Chinese mills that cotton could be carried to Shanghai from the interior, and under resolutions drafted and accepted subsequent to the above mentioned convention, might be released from the necessity of export duty and sold locally upon payment of an additional amount equal to five times the commuted transit tax, or in other words, two and one-half times the export tax. This would make the taxes only 9 per cent. *ad valorem*, but most of the spinners admit that no such subterfuge would be possible.

Under the abolition of the import duties on raw cotton, by a

recent action of the Japanese Diet, the relative values of the Japanese and Bombay yarns, when placed on the Shanghai market are said to be as follows:

JAPANESE YARNS.

	Per Bale of 20 Hanks. Silver.
Raw material	$70.000
Cost of production	10.000
Packing	1.030
Lighterage between Osaka and Kobe	.500
Import duty on raw cotton	1.400
Commission for purchasing cotton	.481
Interest on money invested in purchasing cotton, storage, etc.	1.857
Insurance on import of cotton and export of yarns	.803
Freight between Kobe and Shanghai	.700
Freight between Bombay and Kobe	1.666
Import duties at Shanghai customs	3.209
Wharfage, storage, brokerage, etc.	1.013
Total	$92.659

BOMBAY YARNS OF THE SAME SIZE.

Raw material	$70.000
Cost of production and packing	16.263
Freight between Bombay and Shanghai	.903
Insurance	.446
Cost of lading	.452
Import duties at Shanghai customs	3.249
Wharfage	.042
Fire Insurance	.069
Storage	.125
Brokerage, commission, etc.	1.777
Total	$93.326

It will be seen from the above statement that the prices of Bombay and Japanese yarns are so nearly the same that a very small increase or decrease in the price of the one or the other would enable Bombay to undersell Japan or Japan to undersell Bombay. It is claimed by the Japanese that the abolition of the import duties on raw cotton will give them the benefit of the doubt, as it were, and enable Japan to undersell Bombay. It is furthermore contended that Japanese spinners will in the future

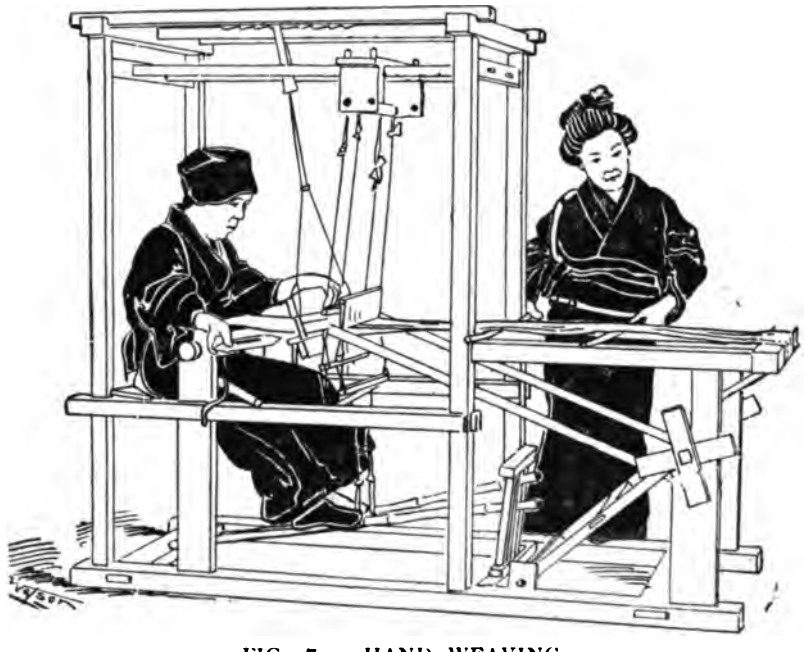

FIG. 7. — HAND WEAVING.

FIG. 8. — HAND WEAVING.

be able to place their goods on the Shanghai market at possibly from a dollar to a dollar and a half per bale cheaper than before.

It has been estimated that the various spinning factories in Japan will derive benefit from the abolition of the duties as follows:

		Yearly Consumption of Cotton. Catties.	Benefit Accruing. Silver.
Osaka	spinning factory	19,923,840	$79,695
Settsu	" "	12,718,080	56,872
Temma	" "	3,503,680	22,015
Naniwa	" "	8,874,880	35,500
Hirano	" "	9,953,280	39,813
Kanakin	" "	6,352,000	26,208
Sensiu	" "	6,935,040	27,740
Asahi	" "	5,372,640	21,490
Fukushima	" "	4,172,400	16,690
Kishiwada	" "	4,008,960	16,036
Dojima	" "	3,674,880	14,700
Okayama	" "	6,943,680	27,775
Tamashima	" "	4,324,320	17,297
Kurashiki	" "	5,540,400	22,162
Kanegafuchi	" "	15,454,080	61,816
Tokyo	" "	8,314,560	33,258
Owari	" "	5,656,320	22,625
Nagoya	" "	5,040,000	20,160
Amagasaki	" "	9,732,960	38,932
Miiye	" "	7,464,960	29,860
Kurume	" "	3,644,720	14,579
Miye	" "	18,506,880	74,028
Wakayama	" "	3,970,060	15,880

These statistics were computed on the basis of the number of spindles in operation at the various factories, each spindle being estimated as having a capacity of 1.2 pounds of cotton per day.

It is not likely, however, that cotton-growing in Japan will ever cut much figure in this branch of industry. The Japanese realize this and they are therefore making a concerted effort to cheapen the freight charges on raw cotton between the United States and Japan. This lies at the bottom of the steamship subsidy and it is with a view of getting cheaper American cotton that these new steamboat lines will be started. The Japanese understand that the future of cotton spinning in Japan rests in

no small degree upon their ability to secure American cotton.

Without a personal examination of all the facts in Japan, China and India, I should not care to express an opinion as to which of these three points is the best for cotton manufacture. I believe the Japanese mills are well organized and economically managed. During my stay in Japan this controversy was started, and in answer to the British claim that Shanghai was the coming place for the cotton industry, the *Japan Mail* said:

"Has it ever come to his knowledge, we wonder, that Japanese cotton mills turn out double the quantity of yarn per spindle that is turned out in England, and 30 to 40 per cent. more than is turned out in Bombay? The Japanese operatives work 11½ hours, and with one shift the mills are kept active for 23 hours out of every 24. Will Chinese hands do better than that, or will the management of foreign-owned mills in Shanghai show a better record? We greatly doubt it. In the early days of Japan's spinning industry, it used to be suspected that the fine dividends declared were taken in part from capital funds. But as year follows year without any change, unless it be still larger dividends, we are constrained to admit that the mills are thoroughly successful. Including the import duty hitherto levied on raw cotton entering Japan, the manufacturers had to pay 7½ per cent. more for their raw material than mills working in India under foreign management. In other words, the Indian cotton spinners had a margin of 7½ per cent. to meet the cost of shipping their produce to Japan and defraying import duty. That ought to have been more than sufficient. Yet the Japanese spinners have beaten the Indian almost out of the field. Witness the following table of imports from British India during the past five years:

IMPORTS OF COTTON YARN FROM BRITISH INDIA.

Year.	Quantity.	Value.
	Catties.	Silver.
1891,	4,548,054	$1,135,459
1892,	8,258,379	1,814,393
1893,	4,865,040	1,243,162
1894,	2,333,625	687,556
1895,	1,341,691	392,631

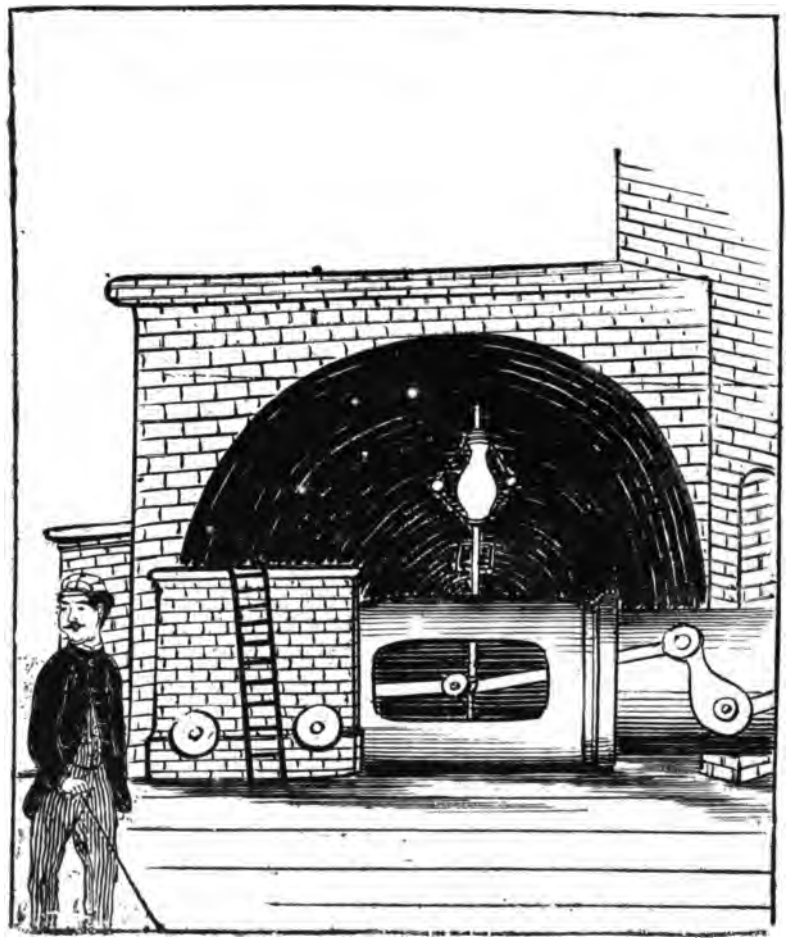

FIG. 9.—A JAPANESE IMPRESSIONISM OF AN ENGINE ROOM.

"If the mill owners in India, with 7½ per cent. in hand to pay the cost of transporting their yarns to Japan and the duty (3 per cent.) on getting them into Japan, have not been able to compete with Japanese mill owners, we do not see how any 'substantial advantage' can be claimed for foreign management over Japanese. It is well to look these things squarely in the face. In the infancy of Japan's cotton spinning industry, we stood alone in our estimate of the serious effects impending over the import trade. Other local writers foresaw only a fiasco for the Japanese. So, to-day, we cannot persuade ourselves that either defective management or inferior operatives can be trusted to secure foreign-owned mills in Shanghai against the competition of Japanese yarns."

In referring to the advantages and disadvantages of Japan in the spinning of cotton, Mr. KANEKO says:

"Now let us see what advantage or disadvantage we may have in this commercial competition to be undertaken in China and Hongkong. We hardly need say that the freight from England to China is far greater than the freight we shall have to pay to ship our cotton yarn to China or Korea. India, too, has to pay a higher freight than we pay. The freight on one bale of cotton yarn from Bombay to Shanghai is about $1.90 (silver), while the freight from Japan to Shanghai is 38 cents. The rate of freight we are paying is only one-third of that paid by Indian shippers. As to the quality of cotton yarn, we may add that whereas the Indian yarn is of a yellowish brown color, our cotton yarn is pure white and bright, and Chinese consumers prefer ours to the Indian yarn. In the matter of freight we have already a great advantage, and, in addition to this, our manufactured yarn excels in quality that produced by our Indian rival and is liked more by the larger consumers. But the Indian spinners have the advantage of being in a position to buy the raw material much cheaper than we can, as a large quantity of raw cotton is produced in India, and they have also the advantage of being able to command much capital at a cheaper interest than we are able to. Moreover, they have the advantage of experience in their industry. On our part, however, we have some other advantages. Labor is cheaper here, and we have an abundant supply of cheap coal. Besides, our people are always ready to replace old machinery by modern and more improved types, whenever they find it beneficial to do so. I should think, therefore, there is some prospect of being able to compete with India and England in the eastern market."

These opinions are only submitted with a view of stimulating debate on the whole question of cotton manufacturing in India, China and Japan, which, as I have said, cannot well be separated.

It is not likely that this remarkable development of cotton spinning and of the manufacture of cotton cloth in the far East will affect the United States very much, so far as its manufacture of cotton is concerned. It may increase the market for our raw cotton. The real sufferer in these changes is Great Britain. It is a question which the British government may well investigate, with the thoroughness peculiar to the reports of royal commissions.

The Kanegafuchi Spinning Company (see figure 1, page 77) is one of the largest in Japan, operating 40,000 spindles, and employing 2,500 hands. Another branch equally as large is under construction, and a company which is an offshoot of this one is now building a third mill at Shanghai. They are tired of buying our cotton of Liverpool. Not only because of the enormous freight charges, but because it gets here in bad condition. I saw nearly 1,000 bales of American cotton in the warehouses of this mill and the same quantity of Bombay cotton. The former was in bad condition, burlaps broken, cotton full of sand and dirt, and only eight or nine cotton ties around it. The Bombay cotton was very different. It was tightly done up with 13 or 14 cotton ties not quite so wide as ours, but the greater number makes much better packages. I did not see a tear in any package — in fact, you could not judge the contents from outside appearance. The only hope of us sharing the prosperity of Japan in the cotton trade is in furnishing the raw material. Those interested should at once join the Japanese in some cheap way of shipping cotton without the tremendous rail journey across the continent. The manufacturer here is anxious for American cotton, he must have it in order to make the next important step in his business. Surely these two interests can devise some plan for mutual benefit.

The Tokyo Spinning Mill (see figure 4, page 91)is a large brick structure, in appearance much the same as our own mills,

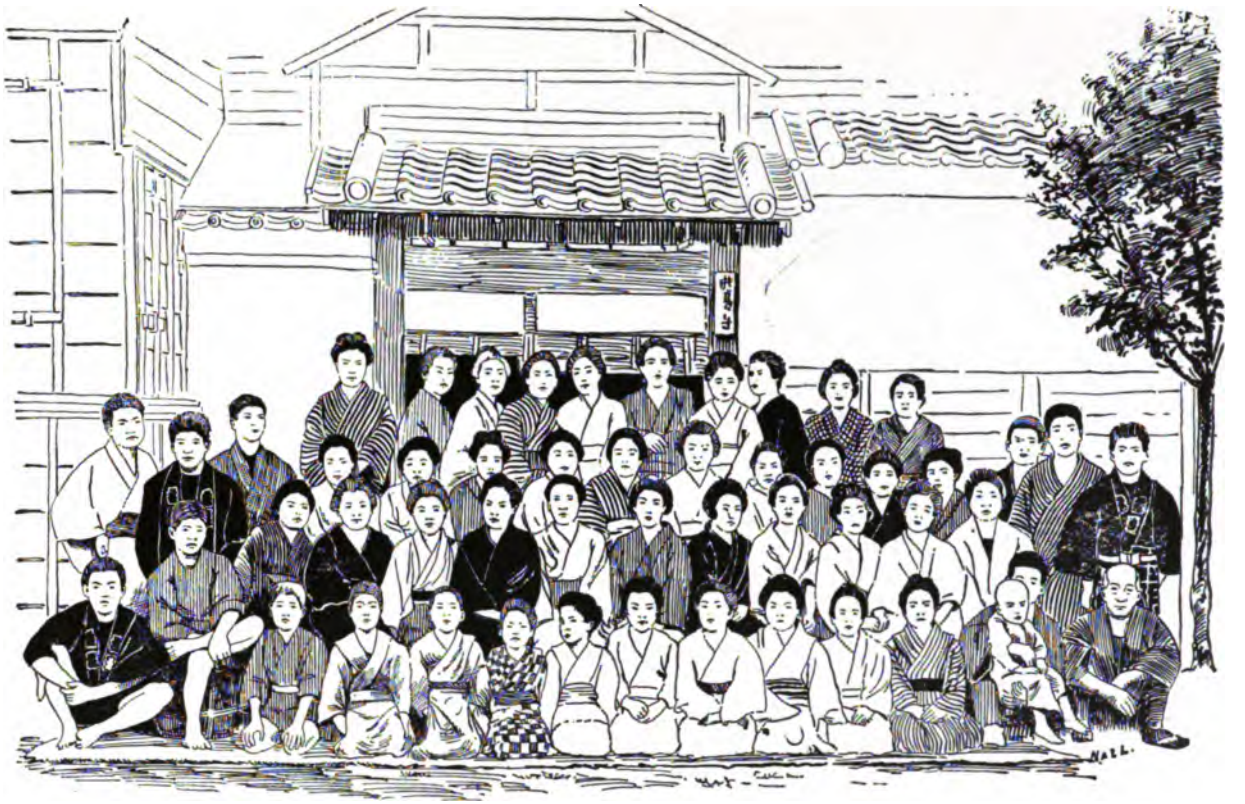

FIG. 10.— EMPLOYES, JAPANESE WEAVING MILL.

excepting that it has an enormous iron smokestack. These are more popular in Japan, because of the frequent earthquakes. These disturbances would be quite sufficient to shake down brick smokestacks, and for a similar reason the spinning operations are all conducted on the ground floor. Consequently the buildings are spread over a large area. In addition to the mill itself, there is within the enclosure a great variety of other buildings, owned by the proprietors of the mill and used for purposes in connection with it.

The pay of the girls ranges from 3 to 8 cents per day. The beginners about make their board. The experienced operatives are charged 3 cents per day for their food. All else is furnished, including a good, large bath, which is used frequently. The girls are allowed to take baths at any time.

The food they get at 3 cents a day is of better quality than the poor can generally afford at their home. Breakfast generally consists of boiled rice and a few slices of pickled radish, or sometimes rice and pounded bean soup; dinner consists of rice and vegetables; while supper, which is to them the treat of the day, consists of rice and fish. In other words, these girls are fed just as maids in respectable families are, or perhaps much better. On holidays special lunches are provided by their employers.

They dress in a dark, heavy, cotton gown, with tight sleeves, but folded over the breast, Japanese fashion. The kimono is abolished in large manufacturing establishments. This seems to be their only garment when at work. On their naked feet are straw and hemp sandals, which cost about half a cent a pair and which really last a long time. For outside wear they have a pair of white cotton shoes, made glove fashion, so the big toe is free, and in this way they hold their wooden outdoor clogs or geta on their feet. These girls dress their hair in both European and Japanese fashion. They look rosy and plump and apparently are contented with their lot.

As to the treatment of the girls, it is impossible to say. My observation led me to conclude that they are well fed; that is,

from the Japanese point of view. They are clean and tidy in appearance, though they have not a surplus of clothing.

The facts herewith given about factory girls were obtained direct from a typical mill and mostly written down by the proprietors.

In small, tiny rooms, devoid of all furniture, the majority of Japanese are born, eat, drink, carry on their work, are married and die. There is this difference, however, between the European thus doomed and the Japanese. The former is keyed up to a different system, and the latter is contented and happy with his lot. In place of the rags, broken furniture and dilapidated utensils of the slums of the European cities, we find four paper walls, neat matting and the utensils that are deemed necessary for existence here. In place of the woolen rags, patched leather boots and miserable belongings of the dwellers in the lower quarters of European cities, we have the scant cotton clothing, the straw sandals and wooden clogs of the Asiatic. As will be shown hereafter, the cost of actual existence at the present time is probably lower in Japan than in any other civilized country.

The men make from 7½ to 15 cents a day. They are dressed in red woolen shirts, with white, close-fitting cotton trousers. They look clean and healthy and work with great dexterity and rapidity. This is equally true of the women. I see no reason why they should not be as expert and quick as any cotton spinners in the world. They are perfectly organized, the machinery is good and up to date, the mill admirably arranged, the rooms well ventilated. The hands receive sufficient food, such as it is. They appear to relish it. They have all the comforts which the average Japanese demands for sleeping. To my mind they are far better off than the dwellers in the wooden boxes and black-painted mud safety vaults which answer for houses in the alleys and crooked by-ways of Tokyo. They have fresh country air in every direction, as the mill is outside of the city and surrounded by rice and barley fields.

The large cities of Japan I found filled with industrial energy, while in the country districts through which I traveled the click

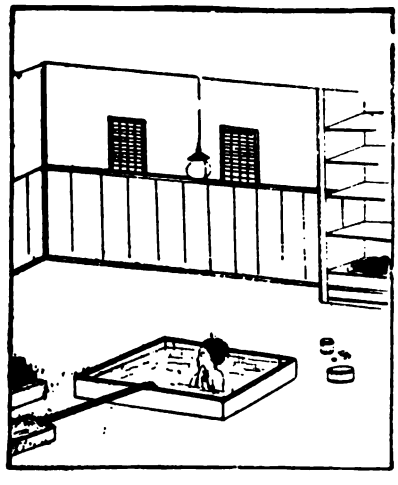

FIG. 11. — BATH-ROOM FOR FACTORY.

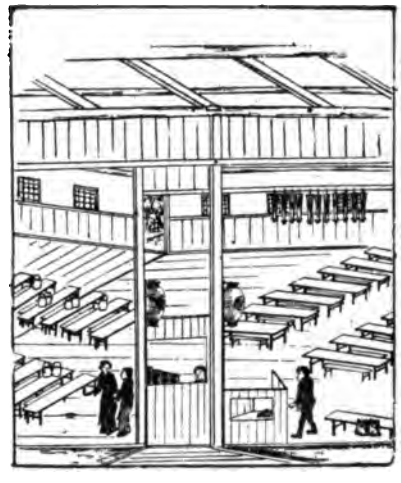

FIG. 12. — DINING ROOM IN A COTTON MILL.

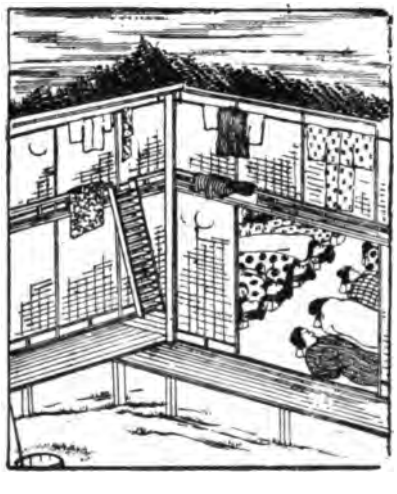

FIG. 13.

FIG. 14. — GIRLS AT WORK IN THE MILL.

of the shuttle and the whir of the spinning wheel may be heard in almost every cottage. Manufacturing seems to run right along the lines of agriculture. The mulberry tree, the silkworm, the filature, the spun thread, the woven cloth, the dyeing and the finishing of habutai, handkerchiefs and crapes are not infrequently combined in one establishment. The background of real handicraft, with labor so cheap and so industrious as in Japan, carried on in the country districts, will be hard to beat, especially when aided by the latest modern machinery.

The looms are ordinary wooden machines, built on the bare ground, in sheds, with rice paper windows and good cypress bark roofs. The treadles are of bamboo and these the girls work with their bare feet. They sit on narrow boards, their feet coming within a few inches of the damp earth. There is plenty of fresh air in these weaving sheds, for that is really all they are.

Sometimes the occupants combine farming and weaving. No matter what the occupation may be, spinning and weaving abound in every house. Some member of the family keeps these crude wooden hand looms going from daylight to dark. It may be a tiny maid of ten or twelve, a budding maiden of sixteen, or an elderly grandame, or even a masculine member of the family. The loom keeps on with its endless threads and one pattern succeeds another with a rapidity which only the dextrous fingers of the Japanese can attain with such implements and under such conditions.

IMPORTS INTO JAPAN.

	1893.		1894.		1895.	
	AMOUNT.	VALUE.	AMOUNT.	VALUE.	AMOUNT.	VALUE.
	Yards.	Silver.	Yards.	Silver.	Yards.	Silver.
Cotton—Chintzes	7,773,182	$635,902	5,155,964	$521,697	3,785,967	$383,364
	Catties.		Catties.		Catties.	
Raw	93,835,718	15,294,897	108,415,609	19,103,922	143,468,259	24,304,814
Yarn	19,405,152	7,284,242	15,942,797	7,977,365	14,591,083	7,082,975
	Yards.		Yards.		Yards.	
Drills	528,225	64,803	1,381,417	172,598	3,693,018	519,972
Duck	106,644	28,833	298,751	94,757	399,761	108,115
	Dozens.		Dozens.		Dozens.	
Handkerchiefs	305,868	164,619	328,065	199,846	335,633	204,683
	Yards.		Yards.		Yards.	
Satins (not exceeding 40 inches)	6,176,483	842,452	7,767,740	1,254,804	4,567,313	784,302
	Catties.		Catties.		Catties.	
Threads	146,958	116,126	123,607	111,203	371,635	328,942
	Yards.		Yards.		Yards.	
Velvets	2,639,634	489,664	2,897,581	700,150	2,209,984	486,097
Shirtings—Gray	38,970,851	2,315,124	41,439,972	2,935,033	46,082,003	3,071,495
White	1,924,619	168,304	3,658,217	337,607	5,394,799	505,719
Turkey Reds	6,130,871	363,587	2,302,398	225,285	5,261,157	418,790

PRINCIPAL COUNTRIES FROM WHICH IMPORTED.

Chintzes or Printed Cotton.

	1893.		1894.		1895.	
	AMOUNT.	VALUE.	AMOUNT.	VALUE.	AMOUNT.	VALUE.
	Yards.	Silver.	Yards.	Silver.	Yards.	Silver.
Great Britain	7,305,434	$592,280	4,959,452	$500,151	3,776,062	$382,106

98 per cent. of total.

Cotton, Raw.

	Catties.		Catties.		Catties.	
China	50,183,891	$7,805,999	51,783,548	$8,120,417	82,171,626	13,,786101
British India	36,592,406	6,052,047	42,354,246	7,846,589	46,683,887	7,693,224
United States	6,160,340	1,273,421	12,056,816	2,680,671	11,996,115	2,338,117

99 per cent. of total.

Cotton Drills.

	Yards.		Yards.		Yards.	
Great Britain	524,348	$64,299	778,677	$108,842	3,678,641	$518,506
United States	2,618	400	602,740	63,755	4,800	499

99 per cent. of total.

PRINCIPAL COUNTRIES FROM WHICH IMPORTED.

Cotton Yarn.

	1893.		1894.		1895.	
	AMOUNT.	VALUE.	AMOUNT.	VALUE.	AMOUNT.	VALUE.
	Catties.	Silver.	Catties.	Silver.	Catties.	Silver.
Great Britain	14,527,812	$6,033,004	13,606,172	$7,288,689	13,247,316	$6,688,066
British India	4,865,040	1,243,162	2,333,625	687,556	1,341,691	392,631

Over 99 per cent. in 1895.

Cotton Duck.

	Yards.		Yards.		Yards.	
United States	78,933	$22,790	293,202	$93,037	397,881	$107,194
Great Britain	25,983	5,788	5,404	1,711	1,012	531

99 per cent. of total in 1895.

Cotton Handkerchiefs.

	Dozen.		Dozen.		Dozen.	
Great Britain	257,018	$127,197	259,436	$149,081	319,174	$191,730
Switzerland	28,387	22,613	£6,491	28,244	13,774	11,640
United States	13	5			2,549	1,277

99 per cent. of total in 1895.

Cotton Satins (not exceeding 40 inches).

	Yards.		Yards.		Yards.	
Great Britain	6,126,366	$834,682	7,486,854	$1,215,829	4,526,136	$776,939
Germany	33,144	5,624	227,706	32,428	37,808	6,730

99 per cent. of total in 1895.

Cotton Threads.

	1893.		1894.		1895.	
	AMOUNT.	VALUE.	AMOUNT.	VALUE.	AMOUNT.	VALUE.
	Catties.	Silver.	Catties.	Silver.	Catties.	Silver.
Great Britain	145,855	$114,119	120,895	$106,640	369,385	$326,033

Over 99 per cent. in 1895.

Cotton Velvets.

	Yards.		Yards.		Yards.	
Great Britain	2,587,956	$470,512	2,823,295	$666,647	2,197,800	$479,638

98 per cent. of total in 1895.

Shirtings, Gray.

	Yards.		Yards.		Yards.	
Great Britain	38,964,756	$2,314,661	41,395,238	$2,931,748	45,991,756	$3,065,164
United States			16,500	1,193	89,743	6,291

Over 99 per cent. in 1895.

Shirtings, White.

Great Britain	1,918,457	$167,798	3,656,750	$337,434	5,363,947	$502,649

Over 96 per cent. in 1895.

Turkey Reds.

Great Britain	6,018,287	$354,489	2,015,183	$197,736	5,131,839	$407,026

97 per cent. of total in 1895.

EXPORTS FROM JAPAN.

	1893.		1894.		1895.	
	AMOUNT.	VALUE.	AMOUNT.	VALUE.	AMOUNT.	VALUE.
	Catties.	Silver.	Catties.	Silver.	Catties.	Silver.
Cotton, raw	344,072	$75,613	540,151	$119,153	774,547	$171,926
Cotton yarn	315,993	59,175	3,538,868	955,529	3,532,893	1,034,478
	Pieces.		Pieces.		Pieces.	
Cotton flannels	188,358	281,151	158,989	221,917	292,415	400,519
Cotton piece goods, Chijimi	605,695	586,969	1,088,389	1,067,572	469,595	585,908
Cotton piece goods, Tenuguiji	54,917	12,484	213,692	58,223	190,662	53,780
Cotton piece goods, other	366,121	228,937	491,647	513,489	1,456,225	1,275,731
	Dozens.		Dozens.		Dozens.	
Cotton undershirts and drawers	96,305	132,270	100,586	133,547	76,657	96,992
	Number.		Number.		Number.	
Carpets, hemp or cotton	203,050	391,989	546,091	1,134,072	685,536	1,635,902

A catty is 1⅓ pounds.

PRINCIPAL COUNTRIES TO WHICH EXPORTED.

Carpets, Hemp or Cotton.

	Number.		Number.		Number.	
United States	114,146	$301,573	333,272	$927,363	318,519	$1,076,049
Great Britain	36,313	42,230	48,035	57,606	111,372	200,417
Hongkong	9,475	13,894	63,928	47,344	89,250	126,777
British America	2,580	6,191	7,025	18,135	20,878	81,508
Russia	25,928	15,628	30,226	22,868	82,393	69,097

95 per cent. total in 1895.

Cotton, Raw.

	1893.		1894.		1895.	
	AMOUNT.	VALUE.	AMOUNT.	VALUE.	VALUE.	VALUE.
	Catties.		Catties.		Catties.	
Korea	338,414	$74,394	530,653	$117,126	752,153	$167,085
Russia	4,639	1,048	8,898	1,898	17,062	4,008
Other countries	1,019	170	600	129	5,332	832

Cotton Yarn.

China	265,117	$48,491	3,270,560	$876,805	2,419,760	$683,087
Korea	26,292	6,302	231,733	68,692	1,081,942	343,578
Hongkong	23,914	4,382	35,700	9,811	30,502	7,620

Over 99 per cent. of total in 1895.

Cotton Flannels.

	Pieces.	Silver.	Pieces.	Silver.	Pieces.	Silver.
Hongkong	55,592	$80,221	81,106	$97,546	164,764	$222,586
China	130,698	196,718	68,565	106,510	108,280	140,275

90 per cent. of total in 1895.

Cotton Piece Goods, Chijimi.

Hongkong	276,581	$256,149	472,927	$425,473	188,766	$181,973
United States	7,639	21,227	28,545	99,428	46,551	151,663
British India	226,088	213,569	438,710	386,681	107,416	96,049
China	53,184	53,299	92,526	86,294	76,094	88,148
Hawaii	38,772	36,463	43,474	41,915	32,983	31,498

96 per cent. of total in 1895.

PRINCIPAL COUNTRIES TO WHICH EXPORTED.

Cotton Piece Goods, Tenuguiji.

	1893.		1894.		1895.	
	AMOUNT.	VALUE.	AMOUNT.	VALUE.	AMOUNT.	VALUE.
Hongkong	51,314	$11,554	194,580	$52,354	174,449	$49,100

90 per cent. of total in 1895.

Cotton Piece Goods, Other.

Korea	43,471	$18,603	258,692	$228,391	1,200,035	$956,321
China	122,874	87,324	158,267	191,594	153,484	175,062
Hongkong	172,547	83,026	41,233	45,115	48,180	53,318
United States	7,265	20,817	4,728	19,534	15,354	35,493
Russia	2,627	2,621	3,694	4,783	11,881	13,626
Great Britain	302	1,137	1,372	4,865	4,529	13,141

97 per cent. of total in 1895.

Cotton Undershirts and Drawers.

	Dozens.		Dozens.		Dozens.	
British India	42,416	$56,756	59,842	$72,677	39,001	$47,229
Hongkong	42,257	55,603	22,317	27,697	26,303	29,783
China	9,185	15,971	8,925	14,194	6,560	9,810

90 per cent. of total in 1895.

The PRESIDENT. I had expected that Mr. PORTER would be ready to answer any questions that the members might ask. If Mr. GOODALE feels qualified to do that, no doubt some of the members have questions which they would like to put to him. This subject seemed to the Board of Government to be an important one. What the cotton manufacturers in China and Japan are doing and can do and will probably do, certainly interests the members of this Association. We expected a paper by Mr. ALBERT W. DANFORTH, but it has not been received, therefore our information in reference to these Oriental markets and to their manufacture is limited to this one paper.

The PRESIDENT. Unless the members have some business to propose, this meeting will now adjourn to the morning session to-morrow at 9.30.

The meeting thereupon, at 9.30 P. M., adjourned to Wednesday morning.

SECOND SESSION.

PROFILE HOUSE, WEDNESDAY, SEPTEMBER 23, 1896.

The meeting was called to order at 9.30 A. M., with a good attendance, President LOWE in the chair.

The PRESIDENT. Gentlemen, if you will give me your attention, the first paper on the programme this morning is by Mr. HERBERT E. WALMSLEY of Newark, N. J., on "The Manufacture of Fine Yarns." I take pleasure in introducing Mr. WALMSLEY.

Mr. WALMSLEY read the following paper:

THE MANUFACTURE OF FINE YARNS.

HERBERT E. WALMSLEY, Newark, N. J.

In view of the fact that the tendency of our Northern mills is decidedly and distinctly in the direction of producing more fine goods than hitherto, and likewise of producing goods of still finer texture and more elaborate styles than formerly, it has, I believe, been felt by the Board of Management of this Association that, at this particular juncture in our history, it would be well and opportune to draw special attention to this subject, and in such a manner, as to arrest the serious and thoughtful consideration of all of us, who are interested in the further development and future progress of cotton manufacturing in this country. That the manufacturers of New England must now turn their attention to a more extensive production of the finer and higher grades of cotton goods, is to-day very generally conceded. First, on account of the increased and increasing production of the coarser grades by the Southern mills; and Second, in view of the fact that so many million dollars worth of fine goods are annually imported into this country from over the water, by which latter fact, we are forcibly reminded, that there is for our Northern mills a large and comparatively undeveloped field, for the production of the finer qualities and more elaborate styles of cotton goods now coming from abroad, and for which we have to pay the foreigner. It is commonly stated abroad, that we have not as yet shown ourselves capable of producing goods which can compare with the goods of foreign make, for quality, tastefulness of weave and finish. In refutation

of this somewhat egotistical assertion, which is certainly incorrect, we only need to examine the product of our leading fine spinning mills as proof that we can and do produce superior high grade, fine yarns, fully equal to the product of the best mills of either England or France.

We can also point with pride and satisfaction to the marked and undoubted excellence of the woven fabrics of some of our leading manufacturers, but, nevertheless, so long as we do import such a large amount of foreign made cotton goods of the finer qualities, we cannot escape from the stigma just referred to, and which, we may candidly admit, is a reflection upon us as a manufacturing community. No stone should be left unturned, no effort relaxed, so long as one ounce of yarn or one yard of cotton cloth comes to us from abroad. We know of no reason why our Northern mills cannot turn out any and every kind of cotton goods equal in quality, fineness, and finish, to the best and most artistic work of the spindles and looms of either England or Continental Europe. The ability to produce such goods, cannot, of course, be acquired all at once. Careful study and practical experience are required. Constant exertion, unremitting vigilence, and the adoption of all the latest improvements in machinery and method, are among the first requirements. In this connection, it may be permitted to refer to what an English textile journal has said, viz.: that such woven fabrics as those produced in Lancashire, cannot be equalled by American manufacturers, until such times as greatly increased facilities are afforded for the acquisition of special technical knowledge, and time has been allowed for the growth of more artistic tastes among designers and workmen.

Fine spinning, fancy weaving, dyeing and printing are not merely mechanical operations, but are justly rated among the fine arts, based on scientific principles, the knowledge of which cannot be secured by amateur or uneducated work, but only and exclusively by thorough, intelligent and scientific study. The enterprise, energy and inventive genius for which the people of America are so far and so justly famed, will, most assuredly, in

the near future, enable the manufacturers of this country to place upon the market such beautiful, artistic and superior fabrics in competition with, and to the eventual total extinction of, the goods now imported from abroad, which represent such a vast amount of money that should be usefully and profitably employed at home.

To proceed with the technical part of my subject: Fine spinning is regarded in England and Continental Europe as altogether in a different category to medium and coarse spinning; in other words, the fine spinner stands, if I may so express it, upon a higher plane than the coarse spinner; metaphorically speaking, he exists and has his being in a purer and more rarified atmosphere, as it were, necessitating finer and more delicate treatment and conditions of life. It is, therefore, on these lines and from this high standard that we approach the consideration of the subject, and, in our treatment of it, we must ever keep in view this position.

The fine spinner knows perfectly well that in every particular and detail, he must have at his command, to enable him to spin superior, high class yarn, the very best machinery, good cotton, well trained, careful and attentive operatives, and, perhaps, most important of all, intelligent and skilful management. With all these advantages, however, in his possession, they will avail him nothing, unless there be a most thorough and perfect system from foundation to roof, with a constant and continual daily and even hourly watching and controlling of the smallest and most minute detail, and to which we shall have occasion to refer later on.

In cotton spinning there are certain clearly defined and fundamental principles which, it is found from experience, should not be deviated from. More especially is this so in the manufacture of the finer grades and higher qualities.

For instance, to produce a certain given quality of yarn, the cotton must be of a correspondingly good quality, and should not fall below the necessary standard, if it is to give the all-important and desired results. Should the cotton be deficient

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tance, and should never under any circumstances be

in quality, there will surely be a depreciation in the quality of the yarn, with a lessened production and a greater percentage of waste. All good spinners fully appreciate the importance of this all-important point, and, when buying the raw material, ever bear in mind that any mistake made here, cannot afterwards be rectified, but, if made, must of necessity result disastrously, when the cotton is passed into the mill to be spun into yarn. In the buying of the cotton, the best spinners should, and usually do, only deal with the best houses; they have then as good a guarantee as is perhaps possible to obtain, that their cotton will at least be as carefully selected as circumstances permit. It is also necessary to examine closely, carefully and thoroughly every bale of cotton that enters the mill, and there should be no hesitancy in bringing before the proper authorities any and every legitimate complaint about the cotton. No effort on the part of the spinner will then have been wanting, in his endeavor to secure the raw material in the best possible condition and manner.

Again, the cotton should be as uniform in quality as possible, otherwise we destroy the very foundation upon which alone it is possible to produce a thread of yarn of uniform solidity, as well as one round, even and strong. Common sense alone teaches that cottons of different staples or fibres in length, strength, diameter and convolution will not and cannot incorporate to advantage, nor can a uniform, level and even yarn be produced when cottons of opposite characteristics are attempted to be worked together.

Again, as has been so well said, to combine the highest quality in the product with the greatest economy of production, the cotton must be as nearly equal in length of staple as possible.

In the insistance, first, foremost and always, of the supreme necessity of buying the very best cotton to be had in the market, due regard to the economical and commercial side of the question must, of course, not be lost sight of, but we do maintain that in the manufacture of superior, high class fine yarn, it is safer, wiser and altogether more advisable to buy cotton a shade higher rather than a shade lower in quality. This policy

if pursued with caution and sound judgment, will be found in the end to be really and actually more economical than otherwise. Such, at least, is the writer's experience in the matter.

When the cotton arrives at the mill, two samples should be drawn from every bale for comparison with the buying samples; and, if it is found that any of the bales are not fully up to sample, such bales should be rejected, and immediate communication should be had with the broker through whom the cotton is purchased. The strictest attention should be given to this matter. Good, even running cotton is the very foundation of the business, and this should ever be kept in mind as a leading principle, when buying the raw material. Another important reason for the thorough and careful examination of each and every bale is that cotton may be classified according to the counts and quality of the yarn required and the price at which the yarn is to be sold. It is desired to make a very strong point regarding the examination and classification of the cotton, which cannot be too minute, thorough and searching, and the person entrusted with this duty, should of necessity be an expert judge of the raw material, and be practically acquainted with the results to be obtained from the cotton.

In mixing the cotton it is imperative to make the mixings as large as possible, the larger the better, for the variation in the different bales is often quite considerable, and unless the cotton is thoroughly well mixed in large lots it is impossible to make a yarn of uniform strength and quality. A large mixing that will last several days or even weeks, is a fair guaranty that so long as this particular mixing does hold out, the yarn spun therefrom will, so far as this process is concerned, be as regular in counts, strength and general uniformity as it is possible to make it. Every time a new mixing is made, however fairly even running the cotton as a whole may be, some variation in regularity, however slight, is the result. To minimize this as far as possible, small mixings should be avoided.

Again, to make up a stack of cotton is a matter of the very first importance, and should never under any circumstances be

left to careless or indifferent hands, or to those who are ignorant as to the very serious results of poor mixing.

When making the mixing, as many bales as the room will permit of should be opened out, brought forward and placed round the square upon which the stack is to be built. A given amount of cotton from each bale should then be passed through the bale breaker, taken and spread out equally over the whole surface of the mixing, beginning at the bottom, and so on alternately, layer above layer, and should be trampled down exactly in the same manner as building a hay stack. We thus get as perfect an incorporation of the whole as possible, by which means a regular and even running mixing is secured, and the element of variation is reduced to a minimum. When it is required to use the cotton, it should be taken from all around the mixing, uniformly and regularly from top to bottom. The opinion, we believe, is held by many mill managers that the labor entailed, and the consequent cost attached to this elaborate system of handling the raw material, before it has yet come in contact with the machinery, is of too extravagant an order, and therefore not warranted. Our experience is, that, no matter whether we are spinning coarse, medium or fine counts, the first cost is more than legitimate and is a prime necessity, the extra cost of mixing cotton in this thorough manner being more than compensated for in the quality of the resulting product, and in the saving of waste in the several processes during the transformation of the raw material into spun yarn. Nowhere is this more noticeable than in the spinning, where, unless the cotton is well mixed, a too large percentage of the valuable roving will, during the operation of spinning, go to waste instead of into yarn.

It may not be out of place in this connection, to point out that in the mills of Lancashire, where competition is so keen, and where profits are almost a thing of the past; in Russia, where the spinning of Egyptian and American cottons is successfully and profitably carried on; and in India, where coarse spinning out of Surat cotton is also extensively practiced; this same system of mixing is in all these countries universally car-

ried out. It is desired to make a strong point of this; in other words, to insist in the most positive and unmistakable manner of the economical and superior results to be obtained, when the raw cotton is handled on the above lines. It is a common saying that one-half of the battle is fought in the mixing room, and this is undoubtedly true. Good fair cotton, thoroughly well mixed, is, we again repeat, of supreme moment, the importance of which cannot be exaggerated and the necessity of which cannot be questioned. If we could further emphasize this in any way or in any stronger language, we would do so. It may be objected that on this question of the raw material, and of the buying and mixing of the same, nothing particularly new has been advanced, and that my remarks thereon are simply a repetition and reiteration of well known and elementary rules. This is in a great measure true, but, nevertheless, regarding as I do this particular department as of such vital and far reaching importance, I gladly accept the responsibility and invite criticism.

It is not easy to set up an exact standard of cotton to spin counts of a given number, for the reason that there is no uniform practice among spinners, some using cotton altogether better and dearer than others, though apparently competing with yarns of the same quality, or at any rate, of the same numbers. Further, a wide discrepancy obtains between the qualities of different yarns of the same numbers. As the capabilities and uses of all cottons are so very varied, and are nowadays spun into all manner and number of yarns, to arbitrarily fix any narrow list of what any particular class of cotton should or could be spun into would only be misleading and of no practical value. Individual judgment and experience can alone determine the question, the solution of which will mainly depend upon the particular purpose for which the yarn is required, and the degree of excellence or otherwise called for. Speaking generally of the following three styles of cotton, viz.: Peeler, Egyptian and Sea Islands, the writer's own experience with regard to Peeler is that it is irregular in both length and strength of staple, besides being quite wasty and that therefore it cannot be regarded with favor.

Egyptian cotton has many and substantial advantages over any other cotton grown and may be used with profit and success for so very many and varied purposes. It is strong, regular and clean, and altogether a most satisfactory and economical cotton to work. It is easily carded, being free from "nep." Generally it is of a brown color and of a fine and lustrous fibre. It bleaches well and readily takes dye. For hosiery yarns it is well known for its superiority, and for fine woven goods it is in great demand. The price and all round capabilities of this cotton place it in the very front rank as a competitor against all comers, for so many branches of cotton spinning.

Sea Island cotton is pre-eminently the cotton for fine spinning, and being the most valuable of all cottons it is chiefly in demand for superior thread yarns, and for the production of the finest fabrics. A very large quantity of this superior cotton is also spun into medium and coarse counts where extra strength is required.

In spinning fine numbers it is necessary to be most careful and particular about the temperature and humidity of the rooms. The heat should not be less than 80 to 90 degrees, and the relative humidity not less than 65 to 75. With the hygrometric conditions properly regulated the practical results obtainable in any country should be the same, although not so highly favored by nature, where the climate, as in Lancashire, is generally damp or moist. Of course, with the addition of humidity the electrical condition is modified and much of the electrical difficulty of a dry atmosphere is reduced to a minimum. Without fear of serious contradiction it may be stated that we are to-day, in all parts of the world where the manufacture of cotton is carried on, practically independent of local atmospheric conditions, and furthermore, are, through the aid of artificial atmospheres, practically, and to all intents and purposes, on an equal footing in all countries. In fact, were we to-day even in the most highly favored localities, dependent upon the outside atmosphere alone, we could not compete with mills equipped with mechanical humidifiers, although the latter were situated in a locality least

favored by nature. Lancashire has long been regarded as specially favored by nature in the element of an exceptionally suitable climate for the successful spinning and weaving of cotton goods, but we see to-day that even there they are universally equipping their mills with various devices for producing the necessary and desired humidity, evidently preferring the artificial to the natural, and presumably because they find the former more satisfactory and reliable than the latter. Nowhere is nature to be depended upon for the supply of a given even and regular moisture; whereas, on the other hand the comparative perfection of mechanical humidifiers enables us nowadays to secure and hold any desired and even running humidity.

Take, again, the extreme case of Russia, with its dry and rigorous climate for so many months during the year and note how successfully they are now spinning 120s combed Sea Island, thus completely defying the elements. Artificial moisture has made it possible to spin these fine numbers in Russia, and artificial moisture is regarded to-day in Lancashire as well as everywhere else where the manufacture of cotton is carried on, as a most vital and important factor in the further scientific development and commercial success of the manufacture of cotton, especially in fine spinning. Cotton, of course, as we all know, spins and weaves best in an atmosphere naturally warm and humid, but where nature has not been so bountiful in this respect, man has supplied the deficiency. It is desired to invite criticism on this point, as so much is said in many quarters regarding our inability in this country to produce the very finest goods on account of climatic irregularities. The writer's opinion, from a varied experience, not agreeing with the views held in this connection, he does not hesitate to say that in the manufacture of cotton, mechanical humidifiers are the all-important factor everywhere, no matter what the condition of the outside atmosphere; and further, that with the means at our disposal of securing the necessary moisture, there is positively no reason why we cannot now spin as fine yarns as are spun in either Lancashire or in France. If proof positive is necessary in substantiation of this

assertion, we only need to point to certain of our fine spinning mills, where they are regularly spinning on the self-acting mule, up to 200s and which yarn we personally know has been pronounced by a very high authority in Lancashire, as fully equal to the best spinnings over there. The writer can likewise bear testimony to the fact that as high as 250s double combed out of extra fine Islands has also been successfully spun on the self-acting mule, in a well known American mill. Hygrometers should be hung up in every room in the mill, and the readings should be taken three times a day by the head foreman, who should enter them in a book kept for that purpose.

Particulars of an 80,000 mule spindle mill spinning 100s out of Florida, Sea Islands, good fair quality yarn, combed:

The machinery and the productions given are to be taken as approximate, subject of course, to modification and revision as circumstances may require; working hours, 55 per week, with 54 hours as the actual running time of the engine.

The productions given are net, allowance having been made for lost time in piecing, doffing, oiling and cleaning, the lost time for these stoppages being roughly taken at 20 per cent. in drawing frames, 15 per cent. in slubbing frames, 10 per cent. in intermediate frames, 7½ per cent. in roving frames and 5 per cent. in jack frames.

Eighty thousand mule spindles 1⅜ inch gauge, 60 inch stretch, average counts 100, at 19 hanks per spindle per week, or about 15,200 pounds per week of 55 hours, from 18 hank, double roving, Sea Island cotton.

One to two openers with one porcupine and one beater.

Two single beater scutchers.

Seventy self-stripping revolving flat cards, 50″ x 38″ cylinders, producing about 275 pounds per week per card.

Six to seven sliver lap machines, doubling 14 ends and producing about 2,750 pounds per machine per week.

Six to seven ribbon lap machines, doubling six laps and producing about 2,750 pounds per machine per week.

Sixty Heilman combers of eight heads each, 8½″ laps, speed

85 nips per minute, producing about 275 pounds per week per comber.

Three to four drawing frames, six heads each, doubling six, and producing per machine about 4,150 pounds per week.

	Diameter of Rollers.	Hank Roving.	Revolutions of Front Roller.	Turns Per Inch.	Hanks Per Spindle for 10 Hours.	LIft.	Diameter of Full Bobbin.	Total Spindles Required.
		average.	average. 300	average.	average.			about.
Drawing,	1½", 1⅜", 1½", 1⅝"							
Slubbing,	1⅜", 1¼", 1⅜"	1.00	135	.60	9.75	10"	5½"	111
Intermediate,	1⅜", 1¼", 1⅜"	2.50	125	1.10	9.75	9"	4½"	111
Roving,	1¼", 1⅛", 1¼"	6.00	85	2.05	6.50	8"	3⅝"	2800
Jack,	1¼", 1⅛", 1¼"	18.00	65	3.60	5.00	6"	2¾"	10000

It will be understood that the machines specified do not in all cases just agree with the production mentioned, as allowances have to be made for contingencies.

When spinning fine numbers, and by fine numbers is meant

100s and finer, it is of less importance to produce much than to producd it well. Nevertheless, it should be borne in mind that with proper care and diligence, it is not only possible, but perfectly practicable, to get good high productions, as the tables given on another page will show. With due regard to quality, quantity must not be lost sight of in fine spinning, any more than in coarse spinning. The spindle point must be closely watched, as so much depends upon the out turn, in keeping down the cost of production, which, in fine spinning, is necessarily high. Spinning from 100s to 200s on self-actor mules, out of Sea Island cotton, the process to be gone through is the regular system of passing the cotton through an opener with one porcupine, 800 revolutions per minute, and one three-bladed beater, 900 revolutions per minute. The automatic hopper feed should be attached to the opener, which greatly increases the regularity of the work, besides, of course, being a labor saver. The cotton is next passed through the finisher scutcher with one two-bladed beater, 950 revolutions per minute, doubling four laps. The speeds of the porcupines and the beaters must not be excessive or as quick as for Egyptian or American cotton. A 30-pound lap should not vary in weight more than one-half to three-quarters of a pound per lap, nor more than one ounce in three yards.

The carding engine is the same in every particular for both Egyptian and Sea Island cotton, as for ordinary American cotton, that is, 50-inch cylinder, 24-inch doffer, 110 self-stripping, revolving flats, with dish feed and licker-in, covered with inserted saw-tooth wire. The speed of the cylinder may with safety be run as high as 160 revolutions per minute, but the weight passed through the card will need to be regulated. Light and quick carding is recommended, but, of course, as in all other things, needs modification, according to circumstances. The necessary number of times to strip and grind must also depend upon circumstances, but, speaking generally, when carding for good quality yarns, either Egyptian or Sea Island, the cylinder and doffer should be stripped twice a day and ground once every

three months. This, of course, is with hardened and tempered, plough ground, or needle pointed, steel wire, which is confidently recommended for all classes of cotton, from Surat to Sea Island. The weight recommended to be put through the card is from 450 to 550 pounds Egyptian and from 150 to 350 pounds Sea Island, according to the cotton and quality of yarn required, for 55 working hours.

The cotton now passes on to the sliver lap and ribbon lap machines. The latter machine is of primary importance for economical and regular combing. The difference in the regularity of the thickness of the lap on the ribbon lap machine, and any other, is very considerable, and can be readily seen by holding it up to the light. In the one made in the ordinary way, there will be streaks showing the position of the round slivers from the draw frame, and in the other it will be equally colored all across, and no signs of variation in thickness can be seen. With regard to the practical value of this machine in the mill, it is an advantage because, as it replaces a drawing frame, there is no extra machine, but, on the other hand, the regularity of the laps presented to the comber is much greater, and the exactness with which the laps can be held by the nipper of the comber is such, that I do not think I exaggerate in stating that there is an advantage of 1½ per cent. in the waste, that is, with the same class of cottons on the two systems. In these days of competition it will be generally conceded that this is a matter of great importance.

In the comber from 10 to 15 per cent. of waste is generally taken out when working Egyptian cotton, and from 16 to 20 per cent. when working Sea Island. In all cotton, of course, there is a variation in the length of the fibre, which is roughly denominated long and short, and each of these two divisions may be further subdivided; the long will include the fibre from the longest down to that which is termed short, and the short will contain all the less valuable fibre and the impurities.

The object of the combing machine, as is well known, is to extract all the impurities and shorter fibres, so as to present for

the subsequent spinning operations a cleaner, more regular, and consequently stronger yarn. The single nip comber of eight heads is run at as high a speed as 90 nips per minute on Egyptian, and 85 nips per minute on Sea Island cotton. This is not considered excessive, and as there is a decided tendency to increase the quality of the yarn by combing, big productions are necessary as a matter of economy.

The important question of percentage of waste at this machine is continually in the front, and one often hears strange remarks on this head. My view is, that it matters not whether we take out 10 or 20 per cent, so long as we do not extract staple. This would seem to be the crucial point, for if there be 20 or any other percentage of useless fibre, and impurities, we comb to get rid of this, and not to haggle over the saving of one or two per cent. of useless stuff.

The combed sliver is now passed on to the drawing frame, and upon a proper arrangement of the drawing and doubling the particular quality of the yarn in a great measure depends. For fine numbers, the question of the fluting of the bottom rollers is of greatest importance, as also the finish of both top and bottom rollers, and all the polished parts of the machine over which the cotton has to pass. Combed cotton, especially, is ever subject to electrical disturbance, and it is astonishing how an invisible defect in metal will show in the mill, with combed cotton in dry, cold weather. In double combed cotton this is so marked that the cotton appears alive, rising and falling in the air without any apparent cause. When the work runs light or heavy, it should be met at the drawing frame, and at no other machine should any changing take place, to compensate for this variation in the weight. If the scutcher laps are kept regular and even running in weight, as they should and can be kept, the only irregularity will consist of uniformly light and heavy work. If by any chance light or heavy work has gone forward to the mules, this must be taken care of at the mules, and not by changing an odd mule here and there, but by changing all the mules simultaneously and at once. This is the only system of changing by which the work can be kept regular.

There are four passages of flyer frames for fine spinning, that is, slubbing, intermediate, roving and jack frames. In all these machines the exactness of the finish of the rollers and flyers is of vital importance. An exceedingly smooth and carefully finished flyer is especially necessary for combed yarns and fine numbers, for unless they are in a highly finished condition, it is next to impracticable to work. The drafts must be set out uniformly, not too much in one frame nor too little in another; the twist, also, must be extremely nicely regulated. The top and bottom rollers must be kept clean and well oiled, and the flats and flyers must be constantly picked and cleaned of all dirt and fly. These frames even for fine work may be run at a considerable speed, as will be noticed by the speeds given as safe on another page. With respect to the covering of the top rollers, in both the frames and the mules, very great care should be bestowed on this matter; the work should be executed with extreme nicety and exactness and the rollers should be covered as tightly as possible, so that there can be no slipping or coming loose of the leather cots. Upon examination of the yarn, it will be found that any extra care and attention devoted to this department is more than repaid.

Coming to the self-acting mules, the chief difficulty to contend with when spinning fine numbers, is slack winding. "Snarls" and "kinks" are a fatal defect in fine yarn and greatly deteriorate from its commercial value. All spinners or minders are prone to slack winding, and it therefore becomes the especial duty of the spinning master to exercise a constant vigilence in this respect, and, as the spinner on fine work is far from overtaxed, he should be made to watch his winding all the time. The spinning master, however, should be held primarily responsible for bad work at the mules, unless in peculiar and exceptional cases. Not even one single set of cops should ever, under any circumstances, be allowed to pass out of the mule room until such set has been examined by the spinning master, whose signature should be affixed to the ticket going with every doff. This system will result in keeping both the spinning

master himself as well as the spinners well on the alert for bad work of any kind, and will be found to be a great check in many ways. There should be a proper system of collecting all bad ends at both the frames and mules, and each pair of mules should be supplied with rovings from certain frames, so that all bad work may be traced to its source. This system should be very thorough all through the mill.

With respect to the sizing of the yarn, a certain number of cops should be sized each and every day, single leas should be weighed, so as to find out the regularity or otherwise of the yarn, and at the same time each lea should be tested for strength. The results should be entered in a book kept for the purpose; this should be submitted for the inspection of the manager every day. Every three months samples of the best spinnings of other makers should be examined for comparison.

Spinning say 250s to 350s, on self-actor mules, the following process has to be gone through and may be taken as a basis on which to proceed in the spinning of all fine yarns.

In the first place the cotton must be of good class of really Sea Islands, not Florida or Fiji. It should be pulled open by hand first, and then opened by one porcupine cylinder running about the usual speed for Sea Island, and then passed by one single scutcher, with the two-bladed beater running at about 900 revolutions.

On this finishing machine a lap will be made weighing $\frac{8}{10}$ ounces per yard. Every care must be taken that the inside of the machines are thoroughly cleaned and free from rough places, and the feed rollers must be set full clear of the teeth of the porcupine or the blade of the beater. Then in the carding the card cylinder if 50 inches diameter, should run from 130 to 135 revolutions per minute, not more, and the card must not be expected to produce more than 70 to 80 pounds per week of 55 hours. The stripping and grinding must be carefully attended to, and it is important to see that no more short fibre and dirt go forward than can be helped. The weight of the sliver coming off the card will be 15 grains per yard, and the card should

make 7½ per cent. of waste. The draft of the card must be considerably more than for 150s to 200s, and the flats should be two inches wide. There should be two feed rollers instead of the dish feed, and no licker-in. The sliver is made into a lap in the ordinary way by passing through the sliver lap machine and ribbon lapper, and placed behind the first comber; naturally this comber will require regulating and setting for the length of the Sea Island staple, and ought not to run more than 60 nips per minute. The first comber should take out 15 per cent. of waste, making a sliver of 20 grains per yard. The sliver made into a lap again and placed behind the second comber, which with the same setting and speed should produce 7 per cent. of waste, and make a sliver of about 20 grains per yard. It is advisable, in fact necessary, to run fine tissue paper through the sliver lap machine and ribbon lap laps the second time the cotton is passed through these machines. This simple device will be found very effective in preventing "licking." When 150s are passed it often becomes necessary to double comb the cotton in order to have as clean and even a roving as possible for working in the mule. With the double combing begins the principle trouble, inasmuch as the fibres in the sliver being parallel, have lost, to a great extent, their hold on each other and the slightest shock or strain is liable to break the sliver; furthermore, although the sliver might not be broken, it is often stretched, making an irregular yarn. There are three passages of draw frames with eight ends up, 7¾ draft, making a sliver of 24 grains per yard. For the class of cotton spoken of the front and second top rollers should be set 1⅞ inches apart and the top roller should not be less than 1½ inches in diameter. Cans with spring bottoms are required to assist the sliver to mount, and the very greatest care must be taken that the passage of the sliver is not obstructed by anything rough or moist. With this double combed cotton everything is so delicate that it has been found that the mere passing of the hand over a polished plate is sufficient to prevent the cotton passing. All polished work should be re-polished with flour emery or rouge and main-

tained constantly in a state of perfect polish. Coming from the draw frame the sliver, again in spring bottom cans, is placed behind the slubbing frame which must be provided with a large japanned or brass roller, to help to lift the sliver out of the can in the passage to the rollers. The rollers are set $1\frac{1}{16}$ inches from front to middle. They have large top rollers, the front being $1\frac{5}{8}$ inches diameter. The sliver made will be a two hank; the spindle makes $3\frac{1}{4}$ turns for one of the front roller. Before using the flyers they must be thoroughly well cleaned inside, and polished as perfectly as is practicable, by drawing soft, untwisted bands with flour emery and subsequently rouge. The cotton becomes highly electrical and will stick in the most astonishing manner to any surface that gives the slightest excuse for doing so. The intermediate is two ends into one and makes a $5\frac{1}{2}$ hank front roller $1\frac{1}{4}$ inches diameter; the spindles make $4\frac{1}{4}$ turns for one of the front roller. The rover doubles two ends into one and makes a 15 hank; front roller being $1\frac{1}{4}$ inches diameter, the spindles making seven turns for one of the front roller.

The jack frame is with soft bobbin flyers, with say six-inch lift, but for the very fine work five-inch is better, doubling the two into one will make a 40-hank roving; the front roller $1\frac{1}{4}$ inches diameter, the spindles making 15 turns for one of the front roller. A 30 to 35 hank roving should be used for 200s, and any roving finer than 30 hank should always be soft bobbin. In all the fly frames the greatest possible attention must be paid to the finish and smoothness of the rollers, flyers and traverses, and on the jack frame the bobbin must be as light as is consistent with the strength required. It is also well to put paper tubes on the jack bobbins, by which means considerably less twist may be put in this very fine hank roving. The skewers on all the frames and in the mule creels must be most minutely examined, to ascertain that there is no unnecessary friction on the pivot, and any bad pot steps should be at once changed, as also any defective skewers. The roving rod and the traverse guides both back and middle, require also special atten-

tion on account of the tendency of this double combed cotton to twist and catch round anything in its way. Coming to the mule, as the cops made are quite small, the spindle is made to correspond.

The mule may have any number of spindles up to 1000, according to the requirements of the trade; we should prefer to have it about 800. The mule consists of say 800 spindles, 1¼ inches space, 14 inches spindle, 6 inches out of bolster, 5½ inches bevel, 50 inches stretch, 3 lines of rollers, single loose boss top rollers, self-weighted, middle and back, bottom rollers case hardened; faller shafts working on anti-friction bowls, the under faller being of small diameter and very carefully balanced. The mule should have double speeds, after stretch, roller motion, and motion whilst twisting, faller motion and patent governor motion. All the speeds both of spindles, backing off, and running up, are reduced much below the average; thus, instead of backing off and running up in 4 seconds, it is as well to take 5 or 5½ seconds, and no mule will spin these fine numbers unless the lighting up be perfect, *i. e.*, when striking the stops, there should be no tendency to rebound; anything of this sort will produce snarls. The under fallers should work very freely and be perfectly sensitive to the touch of the yarn, and the bevel of the spindles will require increasing, and probably the "topping" lowering a little. The number of turns put in the yarn whilst the carriage is coming out, or the number of turns put in at the head whilst twisting, vary very much indeed, from one mill to another, and more so than any variation in spinning coarse numbers. One rule is to put in 75 turns for each turn of a one inch roller when coming out, and more or less according to the quality of the cotton, and to gain coming out 6 to 7 inches and 3 to 4 inches the after stretch. If the cotton is good, the after stretch is increased and the gain diminished, and vice versa.

Another rule for doubling yarns is to put about half the coming out of the other when twisting at double speed, and in this case, with a fair cotton, would gain about 5 inches and stretch about four inches after the rollers stop. Some good spinners of

these fine numbers will only put about 3 inches gain coming out, and put about ⅓ of the turns in whilst coming out, and stretch after the rollers stop 8 inches or 9 inches. The single speed should be about 3000 and the double speed 7000, or even more than this if preferred, but, of course, the backing off and going up must be arranged to correspond, and with rope driving there is no difficulty.

To speak generally on the subject of fine numbers, it may be truly said that the principle difficulty is one of small details in the matter of cleanliness and smoothness, as pointed out; no doubt, according to climatic conditions, the setting of the rollers may require modification, etc.

It may be well to state that a very slight variation in the regularity of the roving from yard to yard, will make in these fine numbers an enormous difference to the numbers of the yarn. Thus in 300s a difference of 30 hanks is nothing at all unusual, and even an extreme difference of 50 is not remarkable. The difference between a successful and non-successful spinner of these numbers consists in avoiding these large variations. This can only be accomplished by great care in details. See that the rollers are equally covered as regards diameter; that the weight of the slivers and roving is frequently checked, and any variation compensated. Furthermore, it is advisable to have the wood bobbins of an absolutely exact weight, and then the bobbins should be weighed and classified, so that there shall not be a greater extreme variation than, say, 5 per cent.

It is scarcely necessary to say that the main element of success in this, as in all other spinning of good qualities, lies principally in absolute cleanliness. The finest numbers usually spun with success on self-actors are 260s; there are mules in France and England which are regularly spinning these numbers most successfully. There is, however, really no reason why finer numbers should not be spun; the only question being one of cost, and the question of market. You cannot afford to spin very fine numbers on long mules, as, of course, the production is great on account of the number of spindles, and the market

for very fine yarns is strictly limited. Another thing is this, that when people spin on self-actors they expect to make large cops, and in these fine yarns the cops will be on the spindles for days and days sometimes, and consequently the part that is on longest becomes soiled with the dust in the room, thus depreciating the value of the yarn. Of course the small hand mules can spin in small cops, and the mules having a less number of spindles are easily manipulated and changed. This, as stated before, is entirely on account of the limited market, and where there is a good demand for 300s, undoubtedly self-actors would crush the competition of the best hand muled yarn.

Very many of the points in the details just given, and all the particularity and exactness referred to as so very necessary when spinning 250s and 350s, may with equal benefit be applied when spinning good quality yarns of any counts, no matter how course. In fact, no well managed mill will allow of any other system.

It of course goes without saying, that to make a successful cotton spinner it is first of all necessary to have a thorough practical knowledge of the business in all its intricacies and detail, from the raw cotton to the spun yarn. But again it is imperative that such knowledge be of an intelligent and skilful order. Men of experience and mature minds are needed to guide and control the business. Men who know how to put into successful operation and take advantage of every opportunity. The superiority of one spinner of superior high class yarns over another is mainly due to greater care and systematic management generally, to strict attention to the daily routine work of the mill, to superior arrangements for securing cleanliness, and to methodical supervision day in and day out of everyone and everything in the mill; more especially is all this necessaay in fine spinning. It is undoubtedly and unfortunately a fact that in many mills there is a very apparent lack of proper supervision, and an utter absence of system, order and particularity, all of which are so absolutely essential where good yarns are the desideratum. The neglect of these factors will account to a

great extent for the inferior and poor results obtained in these mismanaged concerns where there is such an indifference displayed, and which should not exist in a well regulated establishment. It may possibly be news to some of the members of this Association to hear that with respect to cleanliness, organization and discipline, also as regards quality of work and high production for spindle, many of the Russian cotton mills rank as high as many of the best mills of either England or anywhere else in the world where cotton spinning is carried on. These good and satisfactory results are due to the superior intelligence and practical knowledge of the managers and foremen, who are without exception the picked men from the best mills in Lancashire, men who have had long and practical experience and training as foremen and managers, men who have been brought up from boys in the mill and who have gradually and steadily risen from the ranks step by step. In this particular connection it is thought well worth while to again repeat that to carry on successfully the business of a fine spinning mill ability and character of a very high order are needed, and unless such a man is at the head of affairs disaster will sooner or later surely follow. The exercise of a little ordinary every day common sense in the management of a cotton mill counts for much in the consideration of the many questions continually arising, and upon the correct solution of which so very much depends. Thus, for instance, touching upon the question of machinery. While every machine in the mill must be kept in good repair and in perfect working order, all unnecessary expense in alterations or adopting so-called improvements should be avoided, unless it can be clearly demonstrated that they would improve the productive capabilities of the establishment. Many of the devices brought forward as improvements are oftener than not of little real merit, and only further complicate, whereas on the other hand, simplicity must be sought in machines more and more if the cost of labor is to be kept within reasonable bounds. When once a mill has been filled it is far better to let it remain so unless the advantages that might accrue from alterations are very material.

The cleaning and oiling of machinery should be attended to systematically and regularly and at a set time each and every day. The fly frame and mules should be thoroughly and regularly scoured through; the former once every three months, and the latter at least once every month. A given time, neither more nor less, should be allowed for this purpose. The regular weekly cleaning of these machines should also be strictly seen to. The scutchers should be pulled to pieces and cleaned thoroughly once a month, and the dust pipes, etc., should be swept out and emptied once a week. The carding engines should be kept very clean in all their parts, and a general thorough cleaning of them should take place once each week. The combers should be re-set every six months, or whenever the cotton is changed. As the "help" in a fine spinning mill have plenty of spare time on their hands between doffing and creeling it should be strictly insisted that they keep the machines in a perfect state of cleanliness in each and every one of its parts. The slightest neglect or indifference in this department should be severely dealt with. When it becomes understood in the mill that perfect and absolute cleanliness is to be insisted upon, the help will gradually fall into line until, perhaps, unbeknown to themselves, it will become mechanical to them, and they will take as much pride in keeping their different machines as scrupulously clean as the most fastidious management could desire. Exhaust fans should be used in all card rooms, as by changing the air in a room, the atmosphere is kept clear, beneficially to the health of the operatives, and thus less loss is caused by absence through sickness.

In a card room by drawing the air to one point and discharging it at that point, the dust and fine fly is reduced to such an extent that sweeping down is only necessary at long intervals. The result is similar in a mule room. Another very important consideration in the economical management of a fine spinning mill, is the waste question. The price of the cottons used in fine spinning makes it very imperative that every care should be taken in this matter. In one word, not an ounce of

waste should be made that can consistently be saved. Upon reflection, it will be seen what a serious item this is, in the general cost of producing a pound of yarn.

Any neglect or carelessness on the part of the operatives in this respect will result in heavy loss. The waste that is made, and which cannot be avoided, should not be carelessly thrown upon the floors, nor should it be soiled.

With respect to supplies: While exercising a sound economy in the purchase of supplies, there should be no false economy. First cost alone should not be the only consideration; the ultimate cost, in this as in all other matters, should be the criterion. Poor belting, for instance, will be continually breaking down, resulting in a lessened production, and increasing the cost of production all around. Every pound of yarn counts, especially in fine spinning, where the machinery is not run at an over high rate of speed. The scroll and rim banding if of poor quality, will continually require changing, thus again causing too many stoppages and likewise lowering the production. The spindle banding, also, if of an inferior quality, will result in irregular and uneven twist, a serious defect. Card clothing and roller skins should necessarily be of the very best to be had. These points are referred to, not because it is supposed that they are not generally understood, but merely to arrest attention and emphasize the importance of every detail in the management of a fine spinning mill.

There are many matters of detail bearing directly upon the subject of fine spinning and upon the management of spinning mills generally, that I have not considered as coming within the scope of this paper, and with the desire of not monopolizing too much of the valuable time at the disposal of this meeting, it has only been possible to treat lightly upon the various phases of the subject under review. Appreciating, as I do, that this Association is composed of so many able, practical, and leading mill men, the main difficulty that has presented itself in the preparation of this paper, has been, how not to appear in the invidious light of attempting to teach old cotton spinners how

to spin cotton, and it is earnestly hoped that no such impression will go forth.

In conclusion, I desire to say, that I appreciate the compliment paid me by our President and by Mr. KNIGHT, Chairman of the Committee on Papers, in assigning to me the task of presenting this paper. As a member of this Association I accepted the call as a duty, and, whatever the shortcomings in my treatment of the subject, I plead indulgence, for the time at my command has been very limited.

The PRESIDENT. I know that the Association appreciates fully the effort that Mr. WALMSLEY has made and the thorough and comprehensive manner in which he has treated this subject. He has emphasized the importance of cotton spinning and I think you all realize it as manufacturers, especially here in the cloth coming in competition with the southern mills, which are taking up, perhaps more than the northern mills, the manufacture of coarser yarns. It is hoped that this subject will receive considerable discussion. I will call upon Mr. KENT to open the discussion, and Mr. WALMSLEY will very gladly answer any questions which the members may desire to propose to him.

Mr. WILLIAM J. KENT. Mr. President and gentlemen of the Association, this paper, which has been so ably prepared by Mr. WALMSLEY, I can assure you, has been appreciated by me, as I have a great deal of fine spinning to perform and also coarse. But I think some credit should be given Mr. KNIGHT, the chairman of the committee, as he has just entered upon a new field of duty and was very anxious to gain all the points he possibly could on fine spinning, and he could not have selected a more able man to give us these points than the gentleman he did select. And as Mr. WALMSLEY, I suppose, well knows, when anybody prepares a paper to read before this Association, he holds himself liable to answer any questions that may be asked him, if he sees fit to do so. If it encroaches upon any private affairs, we shall not any of us be put out if he says, "I don't care to tell you," for I should do the same if you asked me certain questions. Now I would like to ask Mr. WALMSLEY one or two questions, first, in regard to the humidity of the rooms in which he spins these fine numbers. I notice that he gives a leeway of 10 degrees and states that the heat should not be less than 80 to 90 degrees. I would like to ask him if he does not find that 90 degrees temperature and about 65 per cent. humidity is the best?

Mr. HERBERT E. WALMSLEY. Well, no, Mr. KENT, not in this particular room of which I speak. I gave the extremes, having in view from 80s up to 200s. In this particular room, where we have 90 degrees temperature, and 75 humidity, we find it, I may say, absolutely necessary to keep to those figures to enable us to spin well when we are spinning in that room 150s, 160s, 170s, 180s, 190s and 200s. We do not go to that extreme when we are spinning 100s or coarser.

Mr. WILLIAM J. KENT. I presume the hygrometer you use is the wet and dry bulb?

Mr. HERBERT E. WALMSLEY. The wet and dry bulb; yes.

Mr. WILLIAM J. KENT. Now, the next question I would like to ask you, and I fully realize I may be treading on somebody's corns who sells machinery, but nevertheless, I will venture: I would like to ask if you are troubled with what we call "flaking" on the licker-in when you are using Sea Island cotton? If I do not make myself plain I will further state that some of the licker-in covering which is not only furnished by manufacturers of cotton machinery in this country, but also by foreign manufacturers, has a tooth on it, which is somewhat hooked — it is not a real old-fashioned sawtooth, it is straight up and down — and occasionally cotton will gather on this licker-in and form a film, and then let go and pass in, and as it comes out forms a very small bunch, which, of course, is very hard to detect after it passes through the various processes, but nevertheless is there, and when spinning fine counts shows up at the end.

Mr. HERBERT E. WALMSLEY. Well, we do not have any trouble at all, not the slightest. We have the metallic saw-tooth, with the point — no curve to it, no turn to it at all, in that form — what do you call it, the saw-tooth?

Mr. CHRISTOPHER P. BROOKS. Triangular.

Mr. HERBERT E. WALMSLEY. Yes, it has a triangular point, saw-tooth. We never have any trouble, Mr. KENT, at all. If we had I would gladly tell you, but we never have any trouble at all in the matter you are referring to.

Mr. WILLIAM J. KENT. The next question would be in re-

gard to metallic rolls on this fine work from, say, take it on the ribbon lapper and the sliver lappers in the drawing-frames. Have you ever used those?

Mr. HERBERT E. WALMSLEY. No, we have not, Mr. KENT; we have hesitated to do so. As I said just now, we like to leave well enough alone. It struck me this question might arise, and I thought perhaps in connection with it that I might mention that we positively do not know what it is to be troubled with licking in our top rollers. I attribute it a great deal to the particularity with which we handle our cotton on the start in the mixing room, and right through from beginning to end. We card it well and comb it well, and nothing but staple goes forward, and we really have no trouble at all by licking. We varnish our rollers once a week. We true up all our comber rollers and heavy rollers for draw frames and ribbon lap machines.

Mr. LOUIS SIMPSON. You turn them?

Mr. HERBERT E. WALMSLEY. We true them up and then we varnish them. We do not varnish our rollers beyond the slubbing frame. We have no trouble at all with licking.

Mr. WILLIAM J. KENT. In that connection I would like to ask Mr. WALMSLEY in regard to the ribbon lapper machine. I was very much pleased to find that he used this machine, because it is something that I think is very necessary in the production of good, fine work, and most of the machines which are brought to us from the other country we have trouble in this very point — in licking — as the sliver comes out in that thin sheet from the roll and passes down over that "S" guard. I understand at the present time they are making different arrangements, and they are nickel plating the guides or covering them with brass. I would like to ask if you have any trouble with them?

Mr. HERBERT E. WALMSLEY. No, we do not, Mr. KENT, but we keep our machinery in a very highly polished condition. We use some machine polish, I forget what it is called, and all the machinery through the place is kept in that condition so

that it looks almost as though it were electro-plated. When you once get the polish on, it becomes brighter and brighter all the time, without any special effort. We do not pay anything extra for it, only just what we pay for this polish; but by keeping it in that condition it runs along and we do not have any trouble with it.

Mr. WILLIAM J. KENT. Now, I will ask you just one more question, and that is this: our friend, Mr. ATKINSON, has been of late advocating the double-nip comber to quite an extent, and I notice by the remarks you made here on the comber that you have none of those in your mill. I would like to ask you if you have had any experience with them, and if so, what?

Mr. HERBERT E. WALMSLEY. Well, we have not got the double-nip comber, Mr. KENT; we have not got it at all. We have the single-nip comber and we are running them very rapidly. We shall probably consider the matter of adopting the double-nip combers. We have not tried them yet and do not know anything about them.

The PRESIDENT. Are there are any other questions to be asked of Mr. WALMSLEY?

Mr. STEPHEN A. KNIGHT. I would like to ask Mr. WALMSLEY in regard to the temperature and humidity, the variation Mr. KENT spoke of, and whether that has much to do with the natural temperature and humidity? In other words, if we have naturally humid atmosphere, whether you do not use less or get along with a lighter artificial humidity than you would if it was a dry day, and whether the same applied to heat — if we have an excessively hot day, whether the natural heat or the general heat of the room would not answer equally well to run with a low temperature as it would when the temperature outside is cold and you make the unequal heat?

Mr. HERBERT E. WALMSLEY. Most undoubtedly it would. When we have sufficient natural moisture in the air outside we do not put any artificial humidity in the mill at all.

Mr. STEPHEN A. KNIGHT. What I meant was, for instance,

if we had a very raw and cold day, we made the artificial temperature higher, carried up the temperature in the room to a higher degree than you would do if we had a moderately warm day and a humid atmosphere. I do not know that I make this so that you clearly understand me. What I mean to say is, whether this variation that you make of some 10 degrees is not very largely owing to the natural elements outside.

Mr. HERBERT E. WALMSLEY. No, the variation that I referred to was with different grades of spinning. For instance, take our No. 1 mill, where we only spin up to 60s and 70s—we can do with very little moisture and humidity in that mill.

Mr. STEPHEN A. KNIGHT. Yes, I understand that is so, but that was not exactly the point that I wanted to get before the Association. The point was, in using humidifiers and regulating the temperature, for instance, if the natural atmosphere outside was 80 to 86 degrees, whether we would not run the temperature in the room just about the same, while if it was colder outside we would run up to 90 degrees or thereabouts to get the same result?

Mr. HERBERT E. WALMSLEY. I do not know that the atmosphere outside would affect it at all in that matter, because what we aim at is 90 degrees. We find that that suits us very well, no matter what the temperature outside. For instance, in one of our fine mills we have double windows, and we find they help us a great deal; we keep away the outside atmosphere.

Mr. STEPHEN A. KNIGHT. The point that I wanted to get at is this: it is absolutely useless to attempt to keep all the outside atmosphere away; we have to get more or less of it there.

Mr. HERBERT E. WALMSLEY. More or less, of course.

Mr. STEPHEN A. KNIGHT. The point I wanted to get at was whether it was not necessary or advisable to give a higher temperature with a very low temperature outside, or a more humid condition with a very dry air outside, than it would be when it was reversed, owing to the very fact that we get a leakage from outside of the opposite atmosphere and temperature.

Mr. HERBERT E. WALMSLEY. I fail to see where that comes

in, so long as we keep the temperature inside and the humidity what we require, no matter what the condition outside.

Mr. WILLIAM J. KENT. Mr. President, I think I understand Mr. KNIGHT'S point, and I think it is a good one. The point is—and I think I can explain it to you—the point, as I understand it, is this: if the weather is cold and raw outside, whether or not you do not run the humidity and the temperature higher to counteract the pressure which is outside, the same as a man would a bank account?

If he knew he was going to have a draft come in, or several of them, but did not know exactly how much, he would be sure to have money enough in the bank to meet them. We do the same thing. If it is cold outside we should run our temperature and humidity up to at least 5 degrees more to counteract the pressure.

Mr. STEPHEN A. KNIGHT. That has been my experience.

Mr. LOUIS SIMPSON. I would like to ask this question: In what part of the room does Mr. WALMSLEY take his moisture and temperature?

Mr. HERBERT E. WALMSLEY. We have two hygrometers in each room, in about the middle, as near as possible in the middle of the width.

Mr. LOUIS SIMPSON. Don't you find that there is a great variation between the middle of the room and the walls?

Mr. HERBERT E. WALMSLEY. No, we find but very little variation.

Mr. LOUIS SIMPSON. What system of heating have you, hot air?

Mr. HERBERT E. WALMSLEY. We have different systems. We have the Sturtevant blower in one of our mills.

Mr. LOUIS SIMPSON. Because if you have that, you see your rooms are under pressure and you will not get air in from outside.

Mr. HERBERT E. WALMSLEY. So we do.

Mr. LOUIS SIMPSON. You bear in mind that if you heat your rooms by the Sturtevant blower the air of your room is under

pressure, so that the cold air is kept out. In Canada we have gone to the extreme precaution of calking all our windows in our new mills with oakum, so as to keep the air out.

Mr. HERBERT E. WALMSLEY. That same thing is done in Russia, and they have double windows as well.

Mr. LOUIS SIMPSON. Do you keep the same temperature in your card rooms as you do in your spinning room?

Mr. HERBERT E. WALMSLEY. We do. We have to keep the temperature and humidity well up on account of the combers. If it were not for the combers we should not have to do it.

Mr. LOUIS SIMPSON. And in your cotton room?

Mr. HERBERT E. WALMSLEY. Mixing rooms?

Mr. LOUIS SIMPSON. Yes.

Mr. HERBERT E. WALMSLEY. We have a little heat in there; not much, however.

Mr. LOUIS SIMPSON. In New Jersey perhaps, you don't have much frost.

Mr. HERBERT E. WALMSLEY. Yes, we do in winter time; and furthermore a very irregular temperature.

Mr. LOUIS SIMPSON. In severe frosts do you not find that long staple is damaged in going to the picker room?

Mr. RUSSELL W. EATON. They don't know what frost is in New Jersey.

Mr. LOUIS SIMPSON. Where does the air come from that the blower takes? It must come from somewhere. Perhaps it comes from one of your warm rooms. It may draw from the card room.

Mr. HERBERT E. WALMESLEY. No, it draws from the scutcher room.

Mr. LOUIS SIMPSON. I know, but the fans take the air from the scutcher room, and the air must come from somewhere into the scutcher room to replace the air that is taken away.

Mr. HERBERT E. WALMESLEY. Yes, it will come from the card room or any opening that there may be.

Mr. LOUIS SIMPSON. In some mills it is taken all from the card rooms, sometimes from the spinning room.

Mr. HERBERT E. WALMESLEY. We have nothing of that kind.

Mr. WILLIAM G. NICHOLS. I would like to ask Mr. WALMSLEY at what temperature he keeps the room at night and on days when the mill is not running?

Mr. HERBERT E. WALMESLEY. We keep it up as near as we can at all times and under all circumstances, night and day, regardless of any outside temperature, at the point I told you.

Mr. WILLIAM G. NICHOLS. Both as to humidity and temperature?

Mr. HERBERT E. WALMESLEY. Both to humidity and the temperature.

The PRESIDENT. The next paper on the programme is upon "The Use of the Comber in Cotton Manufacture," by one who is familiar to us all, Mr. E. W. ATKINSON, of Boston.

THE USE OF THE COMBER IN COTTON MANUFACTURE.

E. W. ATKINSON, Boston, Mass.

When asked by the chairman of your committee to address you on this subject, I accepted hastily, not realizing the fact that there was really very little to say which you already have not been familiar with for a long time. Therefore if my remarks seem dull, I ask your indulgence in an effort to add at least some variety, if not some additional interest, to the autumn meeting. After the able and interesting papers that have already been presented, the task set before me is a difficult one.

I am asked to address you upon the "Use of the Comber in Cotton Manufacture." It would be out of place for me to go into a lengthy account of the history of this machine; how HEILMAN caught the idea from watching a lady comb her hair, and how his invention was bought by a syndicate of English machine makers, how they made a vast sum of money out of it, etc. This is all a matter of ancient history. I might, however, take the opportunity to say here that whatever great fortunes may have been made in the past in the manufacture of these machines, there is barely a living profit in the business to-day. Since the expiration of the monopolizing patent, the machines have been both improved in effectiveness and cheapened in price by competition. The price is now less than one-half what it used to be. Thus the use of the machine has been largely extended and it can now be utilized in many kinds of work where its former price placed it beyond consideration. It would also be out of place here to go into the various practical points in connection with the manipulation of the machines. Their con-

sideration belongs inside the mill. Thus the subject about which I have been asked to address you becomes narrowed down very much.

The main uses of the cotton in this country, I put in three classes, the thread trade, the hosiery trade, and the dress-good trade. Of course, there is a large variety of other uses to which combed yarns are put, such as electric work, manufacture of lace, etc. There has also been a large increase in the use of these yarns by the extensive adoption of the bicycle, the tires of which are, to a great extent, made of combed yarns used in conjunction with the rubber. All these may, perhaps, be put in a fourth class.

So far as I know, combers have been used in making cotton thread ever since the latter began to be manufactured in this country on a commercial scale. I estimate that in the last twelve years there have been added about 375 combers for this industry in this country, showing quite a heavy increase in the thread spindles. Twelve years ago nearly all thread yarns were combed as they are to-day, so that in the manufacture of thread there has been no perceptible increase in the use of the comber as compared with the spindles employed. But every housewife and seamstress, together with all the workers in clothing and boot and shoe establishments, must many times have reason to be grateful to HEILMAN for making it possible to manufacture such perfect, strong, and easy-working threads. I am informed that there is some thread still made in England from double carded yarns, but the amount is very small and the quality poor.

In the manufacture of hosiery yarns the use of the comber has been enormously increased, in fact this might be said to be almost a new field for it. Americans are great people for wearing under-clothing. Underwear is far more generally worn here than in Europe, especially among the working people. Moreover, we wear less wool and more cotton underwear than others do. This, I suppose, is owing largely to our dry atmosphere. It has thus become the province of our cotton mills spinning hosiery yarns to develop the softest, silkiest, and best hosiery

yarn that is possible without enhancing its cost too much. Their ability to purchase a cotton comber at a moderate price has enabled them to accomplish this and to develop the industry to a very great extent. Twelve years ago, as near as I can estimate, there were about 100 combers working upon hosiery yarns. To-day there are about 600 combers combing these yarns, from number 10s up to number 50s, and every hosiery yarn maker is to be congratulated upon the beautiful work he is now producing. This cotton hosiery trade would seem to be a peculiarly American institution. Still, it must not be inferred that there is not a large quantity of cotton hosiery yarn spun in England and on the Continent. As a matter of fact, a great deal is spun in England and combed. It is mostly exported in the form of underwear to India and other places where Englishmen use it largely. In France also there is a great deal of combed hosiery yarn made.

In weaving yarns the increased use of the comber has been enormous. Twelve years ago there were not more than one or two mills in all New England weaving combed yarns. To-day there are dozens. I estimate that there are now running about 1,400 combs for the manufacture of yarns for weaving purposes. All this has grown up in the last few years. The increase is owing to several reasons, most prominent of which is the fact that the American women of all classes are growing more fastidious about the materials which they buy for clothing. They prefer to purchase a nice piece of fine goods for a dress rather than a common calico as they used to do and they are quite able to afford the extra price. Again, the rapid development in the art of printing has made it possible to produce most beautiful effects at moderate prices, and with the printers combed goods are great favorites. The increasing use of Egyptian cotton, which is so well adapted to combing, has also had a marked effect. In addition to these reasons we are fast learning the technical points necessary for the successful and profitable manufacture of the finest goods, and we are gradually, but surely, displacing those of foreign make. I am sure that this will

go steadily onward and that with the increased demand for nice high-grade work, and with the reduced importations, the mission of the comber in this country will steadily develop to still greater proportions. I am sanguine enough to believe that as time goes on we shall comb a far greater proportion of our yarns even for the medium and coarser fabrics. We mean to prosper and we mean to have the American public prosper and be able to use and wear the best kind of cotton cloth. This is almost invariably made of combed yarn. There is very little, if any, cloth now made that would not be improved by combing. Combed cotton is rendered stronger, the thread is more elastic, spins better, and weaves better than carded cotton, for the reason that the short staple is taken out, the remaining staple is left perfectly even, and in the early stages of manufacture the fibres are all laid perfectly parallel and subject themselves to the subsequent operations of drawing and spinning much more readily. What is needed to assist the comber and make it still more effective is to get rid of the saw gin, to get our cotton properly baled and handled at the start. This will at once relieve our pickers of much of the work they now have to do, will enable us to do much less to the cotton before it goes to the comb and will materially increase the strength of the yarn and reduce the amount of waste necessary to be taken out in the combing process.

It is this item of waste taken out in the comb that I apprehend prevents many mills from adopting it who might otherwise do so. It is a curious fact that most of our comber waste is exported. This is certainly not as it should be. We ought to be able to learn to utilize this comber waste in a profitable manner. It is a manifest injury to us to sell it to Europe in order to be made up into superior shoddy goods and cheap hosiery yarns which are again sold on this market. We shall listen to a very interesting paper upon condensed yarns from Mr. C. P. BROOKS. The manufacture of these yarns affords a large outlet for comber waste. I have always taken a great interest in this matter and have on several occasions investigated the methods

by which this yarn is manufactured, but, for some reason or other, it has been very difficult to interest our American manufacturers in this class of work. If we could eliminate the waste question, that is, sell it or use it at price equal to that of a strict good middling cotton, then I feel confident that every pound of yarn spun to 60s or upward would be combed, for the reason that the labor cost of combing and the interest and depreciation in combing plant, would be more than compensated for by the subsequent saving in costs of putting the material through the rovers, jacks, spinning and weaving. The goods would not only be made more cheaply but would also be far superior. I am also persuaded that any manufacturer making carded goods to-day out of 1¼ inch staple cotton will make money by putting combers and using 1⅛ inch staple cotton.

It would be out of place for me to make comparisons between the various makes of combers now on the market. If you wish to know about any particular make, you have only to call upon the agent and the information you receive will be limited only by the length of time you will grant him. Suffice it to say that a properly constructed Heilman comb will and is now combing 1⅛ inch. staple cotton without the slightest difficulty, but below that length it is hardly practical to go upon the present machines. A perfect and practical short staple comber has yet to be made. Many have been attempted up to this time but none have really succeeded, in fact, no comber as yet, which has not been constructed upon the original Heilman principle, has ever had any material success.

To conclude and recapitulate, up to 1884 there had been set to work in this country 670 cotton combs, nearly, if not all, six heads each. To-day there are running over 3,900 machines, most of them six heads and quite a number eight heads. This increase is large and has taken place practically since 1889. In spite of this increase the field for the comber has yet only just begun.

In arriving at these figures I am indebted to Mr. WILLIAM FIRTH, representing Hetherington & Sons, and Mr. LEIGH, rep-

resenting the Curtis comb; with my own figures on the Dobson & Barlow machine I am able to arrive at the figures pretty accurately.

The maximum weight of cotton manufactured in this country was in 1892, and reached, in round figures, 1,572,000,000 pounds. Last year it was 52,000,000 less, but we imported and used 42,000,000 pounds of Egyptian cotton, so that we used within 10,000,000 pounds of the maximum amount ever used, in spite of the hard times. Taking 3,900 combers at an average product of 300 pounds per week of raw cotton, or 15,600 pounds each per year, there was combed 60,840,000 pounds, or about four per cent. of the total amount used.

The PRESIDENT. In connection with this paper which has been prepared by Mr. ATKINSON, we have coupled the topical question, "How fast can a combing machine be run and what production will it make, and give satisfactory work?" We had arranged to have Mr. WALMESLEY speak upon this, but in his paper he has covered that ground pretty thoroughly. Will any member of the Association ask Mr. ATKINSON any questions in reference to the speed of running combers, to start a discussion on that matter?

Mr. LOUIS SIMPSON. Mr. President, before coming to the topical question, I would like to join issue with Mr. ATKINSON on some of his statements. It has never been my lot to have

combers, but I have bought and used a great deal of combed yarn in my time, and I found in the old country I could purchase extra well carded yarn that would weave better than combed yarn upon the market for the same price. It seems to me that any one who looks upon combers as the panacea for all the ills that flesh is heir to, makes a mistake; that if he would put the same amount of labor and expense into good carding for warp yarns up to 60s and even 70s, he will obtain a yarn which will give him far more satisfaction in weaving. Of course, I know for special work, where we want to have yarn for filling for sateens, etc., that combed yarn is required; but for weaving yarns for finer goods, in which I have had a great deal of experience, I have always found that I get as good satisfaction from extra carded yarn. I do not mean yarn that has been double carded — I do not believe myself in double carding — but yarn that has been made from cotton carefully selected and which has been put through at a very low rate of speed. On this point I would like to say that I fully agree with Mr. WALMSLEY in respect to cotton buying.

Mr. EDWARD W. ATKINSON. I think that there are one or two statements which I made which I should be rather surprised if somebody did not join issue with me upon. I made them largely for the purpose of drawing out discussion. Of course it is extraordinary to say that a combed yarn was superior for every purpose. There are, no doubt, a great many goods which require to be well filled, where the presence of the short staple, which is taken out in the comber, is almost essential. What the gentleman who has just spoken has said about superior carding seems to me to be a thing which has not yet been carried out to its full extent in this country. He speaks of weaving 60s, carded yarn, made in England. I know of very few mills here that are making to-day the same grade of 60s, carded yarn, that you can readily buy on the other side. As a rule, I think, almost all our mills have many too few cards to enable them to produce that quality.

Mr. ARTHUR H. GULLIVER. Mr. President, I would like to

ask Mr. ATKINSON how it is that the statement holds which he makes on page 166, in regard to 1⅓ inch staple cotton. He says that a mill that is making carded goods out of 1¼ inch staple cotton will make money by putting in combers and using 1⅛ inch staple cotton. I do not understand what he means. Does he mean in the quality of material or the saving in waste? How is it?

Mr. EDWARD W. ATKINSON. I should like to ask what you consider the difference between 1⅛ inch middling grade and a 1¼ inch combing cotton to-day in price?

Mr. ARTHUR H. GULLIVER. I do not know, Mr. ATKINSON, what the difference between 1⅛ inch and 1¼ inch is, but I know that the difference last week between 1$\frac{3}{16}$ and 1¼ was a cent a pound.

Mr. EDWARD W. ATKINSON. I have been told that the difference to-day is about a cent a pound. I made my statement on the strength of a statement made to me by the representative of a mill of very high standing which happened to be doing this very thing, and I expected that its wisdom would probably be questioned. But if there is a difference of a cent a pound between the two cottons, and you can get 75 per cent. of the price of strict good middling cotton for your comber waste, I think, if you figure it out, the net cost of your 1⅛ inch combed cotton as it goes into your draw-frame, will be very close to the cost of your 1¼ inch carded as it goes into the draw-frame. That being the case, the subsequent saving in the cost of putting the 1⅛ combed cotton through the roving machinery, the spinning (that is, the better way in which the work will run) and the weaving, I think, will show a little in favor of combing the 1⅛ inch cotton, as compared with using a higher cost 1¼ inch cotton and carding it only.

Mr. CHARLES W. DENNETT. Mr. President, I do not know that the question is entirely relevant to the discussion, but I will ask it, however. Take, for instance, 1¼ inch stock and the product from that, one sample carded and the other combed,

how much ought the value of the combed to exceed that of the carded?

The PRESIDENT. I take it for granted that the question is asked of Mr. ATKINSON?

Mr. CHARLES W. DENNETT. Yes, sir, or any gentleman who can answer it.

Mr. EDWARD W. ATKINSON. Perhaps some spinner here can answer that more intelligently than I can.

The PRESIDENT. Does any gentleman present propose to answer Mr. DENNETT'S question?

Mr. LOUIS SIMPSON. That is one of the questions that Mr. KENT would decline to answer. (Laughter.)

Mr. WILLIAM J. KENT. I was just going to say, Mr. President, if you called on me, that I was a seller of yarn and had too many good customers here to give that away.

Mr. JAMES FIRTH. I do not see after the paper given by Mr. WALMSLEY that I can add anything more to the subject of the production of combing machines.

The speed given by Mr. WALMSLEY, viz., 85 nips per minute, is the best speed that any comber can be worked at. As soon as you increase the speed over this amount, the machine cannot do justice to its work, either in quantity or quality of production.

By working over this speed it is found that the working expenses are considerably increased, not only in the machine itself, but also in the repairs on the combs, the needles having to pass through the cotton so quickly causes a great number of them to get broken.

With reference to the production of combing machines, this depends a very great deal upon the quality of work required. For manufacturing purposes and hosiery yarns it is found that a combing machine of six heads will produce 300 pounds per week very satisfactory. For fine thread yarns, 225 to 250 pounds per week is all that a six-head combing machine will do and do right.

Whenever an increase in production is required from the

combing machines it ought not to be done on the speed, but by increasing the weight of the lap, and when you do this you have also to increase the percentage of waste to get anything like the same quality of work at the increased production, and by doing this it destroys a great deal of any advantage that may be gained by the increased production.

If you try to increase the production by increasing the speed of nips per minute, the needles having to pass through the cotton so quickly take out more of the good fibre than they will at a speed of 85 nips per minute, and when you increase the production by using heavier lap you can easily see that the same principle works on combing as it does in carding, that by presenting an extra body of cotton to the needles it is impossible to get the work clean.

I do not think that any six-head comber for any kind of work ought to be called upon to produce over 300 pounds per week.

The PRESIDENT. Is there anything more to come under the discussion of this question? If not, we will take up the next paper on the programme, under the subject of "Condensed Cotton Yarn and the Condenser Card," a paper that has been prepared by Mr. CHRISTOPHER P. BROOKS, at present of Charlotte, N. C., formerly from Manchester, England. Mr. BROOKS has given this matter a great deal of study and has prepared some interesting and valuable works upon cotton manufacturing, and I assure you an interesting paper. I take pleasure in introducing Mr. BROOKS.

CONDENSED COTTON YARN AND THE CONDENSER CARD.

CHRISTOPHER P. BROOKS, Charlotte, N. C.

An average mill man on being asked into how many varieties he would classify cotton yarns, taking them in the state in which they leave the spindle, would probably say two only—warp and filling. He might as an afterthought add hosiery yarns. While this is fairly accurate, classifying them according to the use for which they are intended, it is very inadequate as an effort to describe the many varieties of yarn that are made. There are many styles of yarn, just as there are styles of cloth, differing in structure, in ornamentation or in method of production, and the study of the varieties is a great source of interest to the close observer. It is true that many such yarns are made only in small quantities and in few mills, compared with ordinary warp and filling, but they lose none of their interest through this. One of the classes that I refer to is that named in the title of this paper—condensed yarn—which is the name applied to yarn produced on the spinning mule from bobbins made on the condenser card. It practically includes all woolen as distinguished from worsted yarns, all classes of vigogne yarns, real and imitation, barchant and other waste yarns, in addition to some other varieties.

It is with cotton condensed yarn that we are now to deal, and I wish to say here that as my experience in this section of textile industry, as indeed in all the departments of cotton mill work, has been principally gained in various parts of Europe, I

shall treat mostly of European and more especially of German practice, and not so much of American.

The name is given to these condensed yarns because of the special appliance attached to the card. Instead of the cotton being delivered in a single sliver as is customary, there is a condenser attached to the finisher card by which the web is split up into a number of ribbons, 20, 30, 60, 100 or even 120, according to the width of the card and the quality of the stock being worked. These ribbons are felted or rubbed by a suitable arrangement and wound on bobbins which are taken to the mule and spun, thus making yarn without the intervention of railway heads, drawing frames, slubbers, or speeders. The origin of the process is in the woolen trade and in fact a considerable quantity of condensed cotton yarn is made by putting cotton through woolen machinery, pure and simple, but this is not the best practice.

In woolen spinning the European practice is to have a plant of three processes of carding, scribbler, intermediate and carder, varying from cards of three cylinders or swifts in each process for the coarse, heavy or rough woolen work, or secondly, a plant consisting of a scribbler of two cylinders and one large breast, an intermediate of two swifts, a carder or finisher of two swifts and condenser for the medium and finer woolen trade, and thirdly, cards of one cylinder in each of three processes, which is the Belgian system of wool carding, a system that has been eminently successful in some classes of woolen yarn spinning and which I believe is largely in use in this country. I cannot say that it has found much favor in England for woolen work.

The condenser card, whether for woolen or cotton, has the following general characteristics. It is a roller and clearer card, or as it is called in the woolen trade, a worker and stripper card, and immediately over the doffer is always fixed a "fancy" roller, a high speeded long wire roller with the tips of the wires embedded in the clothing of the cylinder, and revolving in the same direction as the cylinder or swift, but at a slightly higher surface speed. The card usually has a special feed arrangement

with more rollers than the ordinary card feed arranged so as to prevent any clogging or lapping of material in the feed part.

The condenser is an auxiliary machine that is placed in front of the card and is capable of separation from the card if desired.

The condenser contains an arrangement for maintaining or producing the separation of the web into separate ribbons or strips, which will be treated of later. The important point of difference of construction in various condensers is in this part of the machine.

The condenser carries one or more pairs of rubbers, which in Europe are endless sheets of leather, a little wider than the doffer, open at the sides, working together in pairs and revolving on rollers so as to deliver the cotton that passes between the pair of rubbers at the front of the card. These rubbers are shown in Fig. 1, at *J*1, *J*2, *K*1, *K*2. Each rubber of the pair has a quick traverse motion from side to side, timed to move in the opposite direction to the other rubber of the same pair. The rubbers being in easy contact it will be seen that any fibrous material between them will be rolled and felted into a rounded form. The front of the condenser terminates in a winding frame by which the threads from the rubbers are coiled on bobbins, shown at *T*1, *T*2, *T*3.

The earliest form of condenser is probably the single rubber on the same principle as the one used for woolen work. In the single rubber and single doffer condenser card for wool the doffer is covered with rings of card wire ¾ of an inch in width and separated by strips of leather ¼ of an inch or less in width. It will be seen that the wool is deposited by the cylinder in strips or bands on the doffer and if these can be stripped separately, but simultaneously, and rubbed into threads, the card of 72 inches will deliver its product as 72 threads. A modification of this form, the double rubber and stripper single doffer condenser, by which each alternate thread is operated on by a separate pair of rubbers, is consequently suitable for long wool, as there is more space between the threads. A third mode in use in England is the double doffer, double stripper, and double

rubber condenser, and I see that some American makers have gone one better and make cards with triple doffers, strippers and sets of rubbers.

The double and triple systems are preferred for many kinds of woolen work if only because all the wool is stripped from the cylinder as soon as it is carded. However, it is not with woolen cards that we have to deal; I only mention them to show the similarity between woolen and cotton cards, and we turn again to the question of the condenser card for cotton.

Two years ago, in rambling over a Lancashire moor, I came across an abandoned mill, and entering it found what I have since learned is called a piecer condenser card. In form the card was of the ordinary roller and clearer type, built almost entirely of wood, but the doffer was clothed with four wide sheets of card wire, with wide gaps from side to side in four places. In contact with the doffer was a roller covered with a pile cloth, a kind of corduroy, and in front of the card was a lattice of V-shaped tin troughs, each trough the width of the card. The card was so constructed that as the doffer revolved the cotton was wiped off it four times in each revolution by the corduroy roller, and dropped in a loose state in one of the tin troughs. At certain intervals each trough was overturned and the loose strip of cotton deposited on a lattice travelling towards a pair of rubbers. The deposits were so timed that the ribbon of cotton just overlapped the end of the previous one on the same lattice. As the two passed through the rubbers together one was pieced to the other by the rubbing action. This caused the system to be named the "piecer system." The most ingenious point was that each lattice only received every tenth deposit, each one of the intervening nine being taken by other lattices. The rubbed threads from all ten lattices were deposited on one bobbin thus making a ten-thread bobbin. This is the only condenser that I know where the fibre is laid absolutely across the thread after leaving the finisher doffer. The shafts carrying the rubbers are at right angles to the doffer shaft and consequently when the material is being properly carded and

the fibres delivered endways from the doffer and parallel to one another they are rubbed in the same position in the thread and lie across the thread.

I have since learned that this plant was in use a generation ago on cotton waste, and that old condenser spinners say that no system has yet been designed which gives so rough and full a thread with cotton, in fact so good an imitation of wool. It seems to me that if machinists would work in the direction of building an up-to-date card on this principle, good results would follow.

The next development in cotton condenser work is the single rubber condenser. It differs from the woolen single condenser in having a fly comb to strip the doffer, and in having the rings of wire on the doffer all set in the same direction.

The doffer, which may be 40 inches wide, is covered with rings of card clothing 1¼ inches wide, with rings of plain leather between. The cylinder thus deposits cotton on the surface of the doffer in 26 distinct ribbons; the comb strikes these ribbons simultaneously and they pass over a grooved guide roll which keeps the ribbons separate and conveys them to the rubber. Passing through the rubber they are gradually rounded and formed into shape by the rubbers, made firmer and firmer, emerging as a loose, thick, untwisted thread. This is a process eminently adapted for some kinds of cotton waste, the better classes, and is largely used. The sample cop marked "waste yarn" has been spun from waste condensed thus. The next step to this is the double rubber condenser card, which depends for the separation of the ribbons on the mode of clothing the doffer. It is in use for cotton work in this country. I do not remember to have seen any used in Europe, and the construction of it bears such a similarity to the double rubber card used in the woolen trade which has been previously described, that I will not take up your time by further allusions to it.

A step of considerable advance takes us to the next group of condensers, namely those having doffers covered with fillet uniformly over their surface. The group includes the Saxon or

leather tape condenser, and the Bolette or steel tape condenser. These are the most suitable ones for better class condensed work in cotton and are largely in use by the most experienced condensed yarn spinners.

The Saxon condenser card, a sketch of which is shown in Fig. 1, is of the usual cotton condenser card construction, one cylinder and doffer, six or seven pairs of rollers and clearers, a fancy and an ordinary doffer comb. The doffer however, in this case, is like the Bolette doffer and is covered entirely with wire fillet, just as an ordinary revolving flat card. You will have noticed in all the condenser cards which I have previously described, the doffers have been clothed in rings so as to divide the web into ribbons. The objection to that plan is that about one-fifth of the cotton that has been carded at each revolution does not leave the cylinder, in consequence of a portion of the cylinder wires meeting the leather rings on the doffer. This is a loss of carding surface and is also deleterious to the cotton fibre, as material may pass the cylinder several times before being removed.

The principle of the Saxon condenser is to take the cotton in an unbroken web from the doffer and divide it afterwards. The cotton after being fed in at the back is carried by the cylinder *A* to the first worker roller *B*, stripped from this by the clearer *C*, and returned to the cylinder; this operation is repeated at each pair of rollers and clearers until the fibres are straightened out and to some extent cleaned.

It will be noticed that the revolving flat card is not used for condenser work. As a rule the stock for condensed yarn is low and the object is to use up as much of it as is possible, without making too much waste. The stock is also often weak staple, and as the roller and clearer card is less severe in its action on cotton fibres it is generally used. As the cylinder passes the fancy *D*, the slightly quicker rotation of the fancy combined with the meshing of the teeth, raises the fibres of cotton slightly so that they may be readily removed by the doffer. The comb *F* strips the web from the doffer *E* in one sheet and this is drawn

between a pair of calender rolls. If 100 threads are desired from the card each of these calender rolls carries 50 leather tapes ½ an inch wide with ½ an inch space between each pair. The tapes run in grooves cut in the calender and the raised ring of metal left between each tape is about equal in height to the thickness of the leather. The lower calender roll *H* is constructed in the same manner, but is arranged so that the ring of metal on the upper calender is opposite to the leather in the lower one.

The leathers are shown by dotted and solid lines. The solid line represents the tape at that part of its motion when the cotton is being carried, and the dotted line represents the same tape after the cotton has been removed.

The leathers after passing around the upper calender pass around other rolls, as shown in the drawing, Fig. 1, until they approach the upper rubber *J*1 of the bottom pair of rubbers. The leathers of the lower calender, on the other hand, follow a path which brings them in contact with the lower rubber *K*2 of the upper pair of rubbers. The calender rolls previously referred to revolve in close contact, and on the side nearest the doffer the leather tapes are embedded in their respective calenders for about one-fourth of the circumference of the rolls. Thus the web enters a pair of calenders with an apparently even surface. Immediately after the cotton passes a line drawn between the centers of the two calenders, the tapes on the higher calender follow their course downward, and those from the lower calender upward, consequently the web of cotton is cut as by 99 knives into 100 ribbons of equal width. Perhaps "tearing" would better express the mode of division than "cutting." The tapes being of soft, supple leather are more adhesive than the calender rolls, consequently the cotton follows each tape until it reaches the rubbers, when it is taken from the tape, passed between the rubbers, and gradually rolled, felted and formed into a thread without twist and without appreciable strength.

In this process it becomes reduced in thickness or "condensed." It is wound on bobbins usually 50 inches wide be-

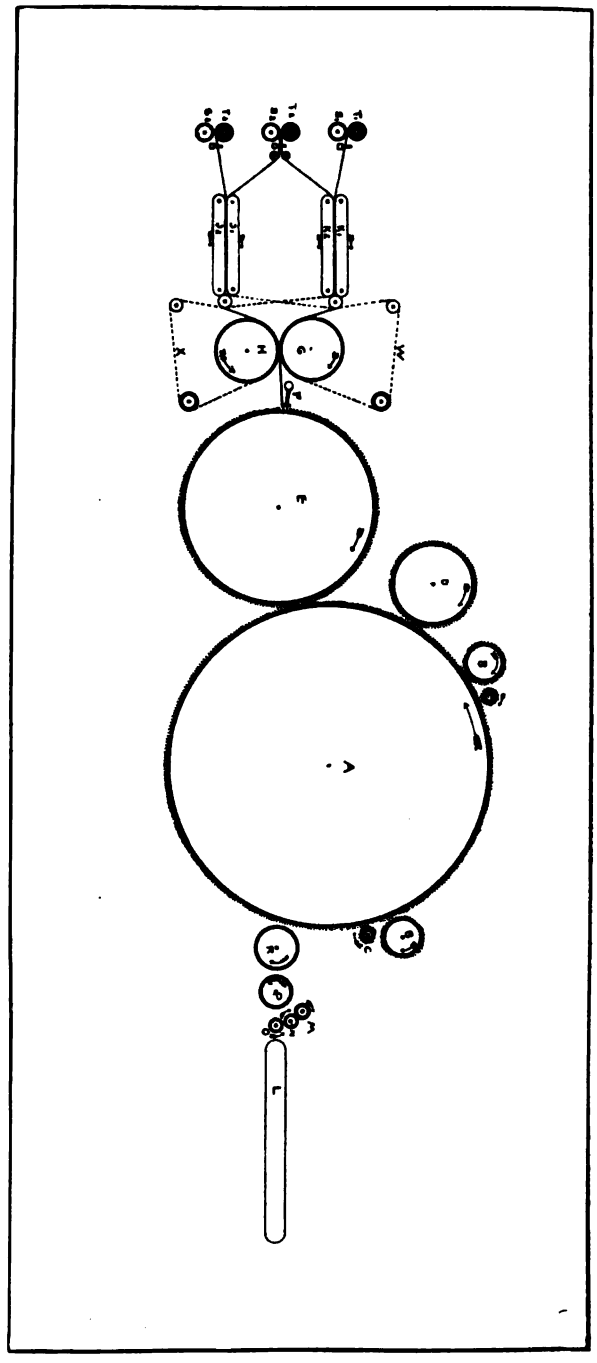

FIG. 1.

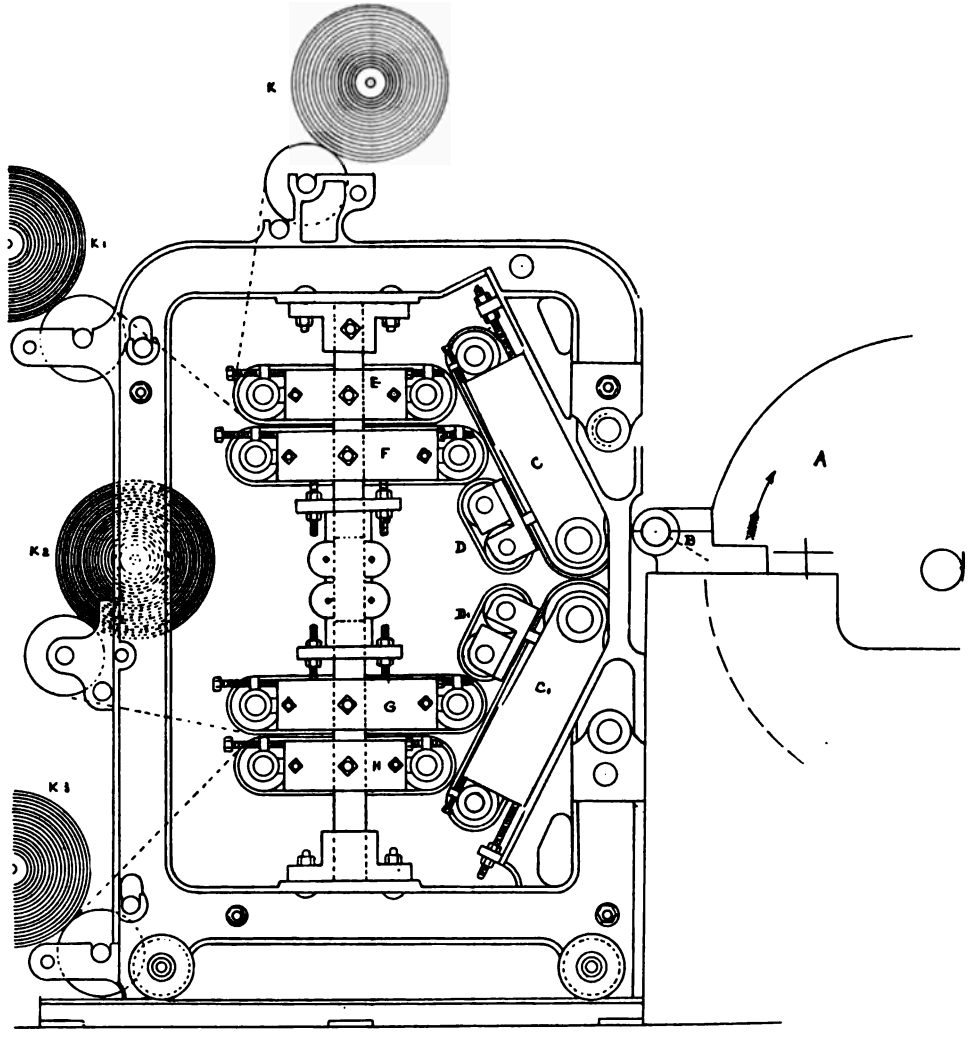

FIG. 2.

tween flanges. The cotton from the two rubbers is divided so as to be wound on three bobbins as a rule, although the drawing, Fig. 2, shows four bobbins. In order to form three bobbins from the two rubbers, one thread out of each three on the lower rubbers, and one thread out of three on the upper rubbers, are taken to a central bobbin. The above system was, I believe, invented, or at least introduced by a Belgian named CELESTIN MARTIN. Another Belgian named J. S. BOLETTE has invented another form of it known as the Bolette or steel tape condenser, which is similar in construction in all parts of the card except in the manner of dividing the web into ribbons. The condenser part of the Bolette card is shown in Fig. 2. Instead of having leather tapes Bolette employs steel dividers, which are used with great satisfaction by some spinners, if they have dry stock to work. Personally I do not like them so well as the Saxon or leather tape condenser. I have here a sample of condensed stock made on a Bolette condenser marked "Condensed sliver from Bolette card." The material is still far from being in a weavable or knittable state. The fibres have merely sufficient cohesion to enable the filament to be drawn from the bobbin by a combined pull simultaneously on all the ends. It has to be twisted and also put in a suitable form for use in the loom or elsewhere.

The operation of spinning is always performed on a mule or some modification of this machine. They all evidently belong to the same species, for the less important forms of the machines receive the names of "jack" and "jenny." The bobbins are placed in a suitable creel, of course much different from the ordinary mule creel, and the ends from the bobbins after passing tin guides go through one line of iron rollers, or may be two bottom lines and one top line, but at any rate with the effect only of a single line. There is consequently no draft in the rollers. The draft, such as there is, is entirely between the spindles and the rollers. The mule, which is usually on the woolen principle, is so arranged that the rollers continue to deliver roving for the greater part of the traverse of the carriage,

but at some fixed point before the traverse is ended, usually about two-thirds of the stretch, the rollers stop and consequently the thread is drawn out by the continued movement of the carriage and spindles, and made even in thickness as well as being twisted to the required strength. It may seem odd to state that this process of drawing 40 inches or 50 inches of half twisted roving into a piece of yarn 60 inches long without the process of attenuation being governed at any intermediate point, makes the yarn more even. A mill man is accustomed to keep the rollers of his speeder or spinning frame set very little more open than the length of staple of cotton that he is working, and finds that if he has his rolls even ⅛ of an inch too wide that his yarn begins to come uneven and irregular. But anyone of you who has watched a mule at work on these condensed yarns can testify that uneven places disappear under one's eye. Thick places are drawn thinner, thin places remain the same, until the thread is approximately of one size throughout. The reason of this is, that twist is being put into the thread during the process of drawing out, and as it is a well known fact in spinning that twist tends to run to the thin part of a thread, the thick places of this yarn remain soft and easy to draw until they are of as small diameter as other parts of the thread, when the twist runs into them and they are drawn no more; the thin places, on the other hand, receive the twist first of all, become hard, and are not drawn at all until the tension on the thread is sufficient. The yarn is usually spun into very large cops which are rewound into a suitable form for the hosiery machinery, or reeled into hanks for dyeing or bleaching. Some yarn, in fact a very considerable quantity, is spun into the usual large cop size, often on a tube, and is in suitable form for the loom shuttle without passing through other processes. I have with me several samples (some of them on tubes) of yarn suitable for weaving purposes, which I have obtained in various parts of Europe, and which are marked "filling yarns."

I have now, possibly in too elementary a fashion, treated of the machinery for condensing and spinning the stock, putting

the wagon before the horse, for I have left over the consideration of the preliminary stages of the working of the plant, which is of importance. As to the proper preliminary treatment a great deal depends on the stock being worked. The system recommended in one of their pamphlets by Messrs. Platt Bros. & Co., the well known English machinists, who have their condenser plants working in all textile countries of the world, is, for short stapled rough cotton, first to treat the material with a willow to clean and mix the stock, then use a Crighton opener and a single lap machine. After the lap is formed they treat it in a breaker card single cylinder and pass it to the finisher card, which has the condenser attached. That is an admirable system, but is merely one way of arriving at the result. The stock worked on condenser cards varies from mill sweepings soaked in oil and dirt to clean American cotton, and includes stock so soft and tender as comber waste on one hand and harsh, stiff, dyed stock on the other. The ideas of mill men on the most approved system consequently differ according to their experience, but all plants may be considered to consist of a willow or duster to mix and clear the stock and add necessary ingredients to the mixture; a scutcher or picker with or without a lap-forming delivery; breaker cards of one cylinder with lap feed or raw stock feed, rollers and clearers, and a delivery arrangement either positively connected with the next card, or one of the other numerous devices that will be treated of later.

Ordinarily the stock then passes to the finisher card, but in some cases where triple carding is considered advisable, an intermediate or second breaker card is used of similar construction to the breaker, with one of the special deliveries suitable for feeding the finisher card. As I have stated, the finisher condenser card is occasionally one of the forms of a woolen card, but more frequently and much more satisfactorily, is either a Saxon condenser card or a Bolette condenser card. One reason for not adopting the woolen card *in toto* is that in cotton work, as a rule, the staple of the material being worked is of fairly even length throughout its bulk, and two swifts are not required.

Viewed under a microscope the structure of the condensed yarn is shown to be very different from ordinary cotton yarn. While the latter shows the fibres arranged approximately parallel and twisted uniformly so as to make a compact and apparently solid filament, the condensed thread shows the fibres laid irregularly, in fact not laid at all, but meshed or felted. The yarn is also distinguishable by the feel and pull when broken. While ordinary cotton yarn usually breaks with a crack the condensed yarn draws asunder. The strength under the testing machine of condensed yarn is of course much less than the ordinary yarn, number for number, even from the same stock, but on the other hand condensed yarn looks fuller in the fabric for the same weight.

The loose condensed yarn also makes it a very suitable one for goods intended for napping, and consequently it is used very largely for this purpose. The goods can be napped by fewer runs through the nappers than from ordinary mule spun yarn. I have previously referred to the fact that there is no roller draft in spinning condensed yarn, and this feature aids in utilizing both long and short stapled stock even when mixed together. For the same reason wool and cotton, or silk and cotton, can be mixed and spun with great facility. The so-called "union" goods are largely made from this process and the union is often a very unequal one, for the mixture may contain 97 per cent. of cotton, with three per cent. of wool to swear by. There is a sample of this in the room.

The machinery cleaning cloths now used are woven from silk waste spun on condensers. It has been my good fortune during the tenure of my appointment as Textile Examiner to the English Technical Schools, to have been sent on several occasions to various places on the continent of Europe to report on special industries or new processes. It was in Germany on one of these occasions that I first saw a mill working exclusively on cotton and equipped solely with condenser cards; this was in Saxony. Since that time I have given some little attention to the observation of condenser work in various countries, and I must say

the Saxons hold the palm in the condensed yarn industry, whether on the ground of quality of production, quantity produced, or the high degree of technical skill brought to bear. For many years they have carried on the trade successfully, and now control condensed yarn mills in Russia, Sweden, Italy and other countries, which they have established to avoid duties on exported German yarn. A great deal of the Saxony yarn arrives in this country in the form of hosiery.

In Italy I have also seen condenser cards at work, and in fact a very large number of "assortments" as they are called find employment there, and a good trade is done with South America by Italian mills.

As I have stated, I am unaware as to the existence or extent of the industry in the New England States. I have seen some but not much of it during my one year's residence in the South. In England it is employed to some extent but not so largely as it ought to be. In fact, England imports condensed yarn and exports waste from which condensed yarn might be made. The subject is now receiving more attention and the former neglect of condensed yarn spinning will doubtless be remedied in that country.

It appears to me that at the present moment the economic conditions of the cotton industry in New England and Old England are in many respects similar, and both are being threatened by competition, which, though coming from different sources, is similar in effect and requires similar remedies.

England has for many years been shipping new textile machinery away at such a rate — sufficient to equip an 80,000 spindle mill weekly — to such countries as India, Japan and China, but more particularly to the Continent of Europe, so that former customers for yarn and cloth have been turned into competitors, and the demand for coarse goods and easily made fabrics in all the markets of the world is, generally speaking, diminishing. Here in the older manufacturing section of the United States you are feeling the competition of another section that formerly was a customer, but is now a competitor although

a friendly one. The Southern States of the Union are supplying their own needs in the coarser fabrics, and not only doing so, but threatening to capture your old markets for export goods, such as China.

To my mind there are two remedies for these parallel cases, and the remedies are so closely allied that it is impossible to separate them. One is to introduce and maintain at any cost the most efficient system of technical instruction that can be devised, and the other is to turn the mills to goods that require skill in making — maybe finer goods, more elaborately finished goods, or more highly ornamented and better designed ones. The varieties that can be made are endless, for new departments of textile industry are invented just as new machinery is invented.

One of the varieties is the class of yarn with which in this paper I have endeavored to deal. From the collection of samples which I have with me — a somewhat small one — you will be able to judge of the variety that can be obtained in condensed yarn. Many of these samples were made during the last three years in a mill under my management, and others I have collected.

England has tackled the problem of remodelling her cotton industry on the lines indicated above, and without any flourish of trumpets is quietly but quickly changing her trade. There is no doubt that ten years to twenty years ago the Germans and Swiss were forging ahead very quickly. Their introduction and rapidity of extension of technical schools gave them a lever which no other nation possessed, and the superior skill of her textilists was proved by the fact that less than ten years ago Manchester drew her skilled dyers, Philadelphia her skilled designers, and France and Italy their skilled mill managers, from either Germany or Switzerland.

Germany is now reaping the fruits of the establishment of textile schools in the greatly increased foreign trade which has developed rapidly and made Hamburg the greatest shipping port in Europe. When the fever of inquiry on the subject of tech-

nical instruction started in Europe ten to fifteen years ago, Germany was an easy first, but that is not so to-day. There will be during the ensuing session probably more technical schools at work in England than on the whole Continent of Europe, and also better equipped ones. They are already having effect. In the last three or four years there may be marked a decided change in the cotton industry of Lancashire toward finer counts, fancy weaving, and novel processes for the production of cotton yarns and cloth. It will take some years for the full effect of the technical education movement to develop, but the fruition will come and the crop will be gathered, just as Germany is reaping her reward to-day.

In respect of technical education I am afraid that you, on this side of the water, judging from the papers read on technical institutions at the last meeting of this Association, have not gone ahead with the usual American energy, but in the matter of changing and elaborating the product of the mills you in New England may have done so. As I hope I have sufficiently good sense not to treat of what I do not understand, I will leave it for some member to refer to this point in the discussion after the reading of this paper.

Without desiring to assume the position of an authority or of a prophet, I certainly feel that there is a field for the development of condensed yarn spinning. The great reduction in the number of processes necessary to manufacture yarn, the reduction of labor costs, the utilization of waste products, which has always been found to be a source of economy and profit in large industries, when all other economies have been run into the ground, and the elaborate effects that can be produced with such little expense, point to the condensed yarn trade as one worthy of attention in these days of reduced margins and close economy.

In conclusion, I would like to express my appreciation of the opportunity that has been granted me to address an association which is practically unique in the textile world, and the proceedings of which I have followed for a number of years. I would like also to say, like Mr. WALMSLEY, that the time which

I have had to prepare this paper has been very limited and consequently I must ask your indulgence for any short-comings in connection with it. If I had had longer time at my disposal I would probably have obtained from Europe a much larger collection of samples and also had more illustrations prepared to help to illustrate the subject.* (Applause.)

* Since the above paper was read, Mr. BROOKS has been appointed Director of the Lowell Textile School, Lowell, Mass.

The PRESIDENT. The paper which has just been read relates to what is something of a departure from the usual carding and spinning, and I think there may be much interest in it. I would like to call upon Mr. WILLIAM G. NICHOLS to set in motion some little discussion upon the condenser card and condensed yarns.

Mr. WILLIAM G. NICHOLS. Mr. President, I shall have to begin as Mr. BROOKS and Mr. WALMSLEY ended, by saying that the time for preparation that I have had is very short, consisting of a notice of some two or three minutes. It was my fortune once to work about a woolen mill, and it seems to me that the process which I observed in a cotton mill here in the North not long ago making condensed yarns, resembled very much, as Mr. BROOKS has said, the manufacture of woolen yarn. The machinery seemed to be almost exactly the same — what are called in the woolen mill the first breaker, second breaker and finisher, and the methods of evening the yarn and doubling were exactly the same, except, perhaps, perfected a little more. The yarns that we have seen here and that I saw being made then for the first time out of cotton waste, out of sweepings, in fact, surprised me by their evenness and strength, considering the material that was put into them. And having had some experience in the manufacture of nap goods, it seems to me that they might well be employed in that work, although I cannot speak from any experience that I have had. I would like to emphasize the point that has been made by Mr. BROOKS in the last part of his paper. It seems to me true that we have not paid sufficient attention here to technical education, and the paper that we had at our last meeting and some to follow at this one seemed to me well timed. The competition of Southern mills is forcing us into other avenues than those that we have followed in manufacturing, and I hope that this Association will

take steps to further textile education more than it has already taken. The tendency here in the North seems to be toward goods made with a wider variety of material — mixed material, cotton, wool and silk — and toward a larger variety in weaving. I think there has been, so far as I can see, a great advance made in the last few years in the variety of cotton goods manufactured, and the point that seems to me well worthy of attention by Northern men is the furthering of textile education by investigation and study and the setting forth, as we do in effect here, of new processes in manufacture, which will show new means of using our waste material and new combinations of material, the manufacture of new goods and goods useful in new ways.

The PRESIDENT. Is there any other member who is interested in this particular subject?

Mr. JAMES P. TOLMAN. Mr. President, Mr. BROOKS has told us — and it was also in accordance with our previous understanding — that this system is never applied to cards of the top flat or revolving flat type, but only to roller cards. I should like to inquire whether there is any inherent reason why stock — not the very lowest grades of stock, but stock which would naturally be worked upon the revolving flat cards, should not be worked on the condenser system on the top flat cards; whether the condenser is not perfectly practicable to be used with cards of the ordinary type?

Mr. CHRISTOPHER P. BROOKS. It is certainly quite practicable to use the revolving flat cards for this condenser work. But, as I have explained, the object is very often, possibly in most of the assortments, to use up waste, to use up low stuff and utilize as much of the fibre as possible. They have the grids very close to the cylinder and they make very little waste indeed. Consequently the use of revolving flat cards would make more waste than desired. There is no reason in the world

why a revolving flat card should not be devised, possibly with fewer feats, so as to leave more room over the doffers to place a fancy roller, so as to make high class condensed yarn for certain purposes.

Mr. LOUIS SIMPSON. I would like to ask Mr. BROOKS if the product of such cards would be as much like wool as the product from the present system of carding? I understand that most of these yarns are used to produce goods to imitate wool, and I should imagine myself that the flat card would smooth the staple and make the product more like cotton than the product from the woolen card. Is that so?

Mr. CHRISTOPHER P. BROOKS. That is so to some extent, but still you would be able to get the required result. Possibly not more than half of the goods are made to imitate wool. For those that are not made to imitate woolen goods, the revolving flat card can be used. By means of special feeds between the breaker and finisher the fibre can be crossed even when a revolving flat card is used as a breaker.

The PRESIDENT. We will now pass to the next question, which seems to me a very important one: "Can as marketable goods be made from frame yarns as from mule yarns?" This discussion is to be opened by Mr. GULLIVER.

Mr. ARTHUR H. GULLIVER. Mr. President and members of the Association, I want to say one thing before I read a few sentences that I have written in regard to this question, and that is, it seems to me that the whole question of marketableness of our cotton goods really belongs to the selling house rather than the mill. A great many of us have questions brought to us by the treasurer or the selling agent in regard to making changes in goods. We do not always know what the objections made by the buyers are to these very goods. And so the paper that I am going to read will look at the question more from the standpoint of the manufacturer than it will from

the selling agent's standpoint. I confess I was a little at a loss to know from the wording of the question whether it referred to what the cotton broker or the commission house wanted, or whether it was what was wanted to make satisfactory goods that would pass our cloth room. I suppose that it refers to what the commission merchant wants in the line of goods. I must acknowledge that I do not really know how I could treat that satisfactorily, so, as I said before, I have taken the standpoint of the maker rather than that of the seller of the goods.

There is always a demand for goods having certain special effects; in some of them it requires a special weave, and in some it means the spinning of a peculiarly soft thread. With these fabrics the yarn spun on the filling frame does not come into competition, and we would not feel like arguing the above question in regard to them, as the mule is the only machine that can produce the soft thread needed. But taking it in a broader sense, it is surely true that on regular plain goods or fancy weaves not of the classes mentioned above, it will not be a mistake to replace mules by frames. The only question is the quality of the yarn, and that will be better when spun on frames. It is cleaner, with less chance for soft bunches and coarse ends from the threads running together. It is stronger in proportion to the number, both from using double in place of single roving, and putting in more twist than on mule yarn. On number 36 yarn it would be about one and a half times more rather than less than this on good stock.

This twist will give a more even thread, and one that will have fewer weak places, as any imperfection in the yarn will cause it to break with the drag of the traveler, and not wind on, breaking later in the loom. We have a more satisfactory thread for weaving when the bobbin leaves the frame, and more yards to run with one threading of the shuttle. These two things will give better cloth on the loom, that will be freer from imperfections caused by tender filling and changing shuttles. There is still another advantage, the harder wound thread on the bobbin, which prevents the filling coming off in bunches, as is frequently

the case with cops. The cloth when woven looks better, and has an evenness lacking on the goods woven from mule filling. The face is a little rougher on account of the extra twist, but this is only noticeable in the unbleached goods. After bleaching the goods look better than the others, and if sold on their appearance cannot fail to suit the market. They may require a little different preparation in finishing; the amount of starch used may be slightly more, and there may be some difference in the cost. On the whole, we feel sure that there is no mistake in putting looms on frame filling, and the limit of its use has not been reached. A few years ago 40 yarn was as fine as it was considered safe to go; to-day we would say 60, and then we have not reached the limit, as yarn finer than 80 has been satisfactorily spun on the frame.

I would add here that I do not think I have ever seen common cloth that was woven with bobbin filling where bunches were made except from a bobbin that was run too full on the frames. Of course we all know what the trouble is with cop yarn. If we have an end down on the mule and the spinner does not raise the cop sufficiently, we have a place that is soft and will nine times out of ten make an imperfection in the cloth.

Mr. CHARLES H. FISH. To begin with, the term "marketable goods" as used in the question, would indicate that the subject must be approached not only from the position of the manufacturer, but also from the position of the buyer or converter. There may be a certain prejudice, especially among older manufacturers, against the use of ring filling, which perhaps can to some extent be accounted for by the fact that the method of spinning filling upon ring frames is comparatively new.

There are those, however, who have gone so far as to throw out mules which were in good condition and substitute the ring frame.

This might indicate a positive confidence in the ability of the ring frame, as against the mule, to spin as satisfactory yarn, which when woven would make as "marketable goods," were it

not for the question of cost, which I understand is not to enter into the discussion at this time.

In the practice of to-day we find the use of frame filling almost universal in certain sections, especially on coarser yarns and cheaper grades of goods, while in other sections the mule still holds the field. Print cloths or plain work of this character are made both upon mules and upon frames, and each cloth is sold in the market without this point being questioned.

As we depart from the coarse or medium counts and also from the lines of plain weaving, we seem to approach a point where it is advisable to abandon the frames in favor of the mules. Just where this line exists is a question of considerable uncertainty, and one which I would expect would call forth interesting discussion.

It would seem that there is no doubt but that the use of the ring frame for spinning filling is limited in two directions, namely in the number of the yarn and also the character of the goods to be woven. My own experience would show that the more prominent the filling the more it would seem desirable to use mules for spinning it.

Five harness sateens woven in the Cocheco Manufacturing Company's mills are, generally speaking, more satisfactory where mule spinning is used although mule and frame filling are both from the same roving with practically the same draft and twist, but there is something about mule filling and mule cloth which is attractive, although we all no doubt will agree that the mule itself with its attachments, is a rather uncomfortable animal.

In answering your question, therefore, I should say that it depends largely on the character of the goods, frame filling being a close rival to its older brother, throughout the coarser and plainer grades of cloth, but lagging noticeably behind as the better grades are reached, and gradually falling out entirely as we get in the range of fine numbers.

The PRESIDENT. I think possibly Mr. KNIGHT will consent to give us some ideas upon this question.

Mr. STEPHEN A. KNIGHT. Mr. President and gentlemen, this is the first notice and the first thought I have given to the matter. It had not been suggested to me and I had not given this subject any consideration whatever. But I hardly know just how this question should be applied — whether we mean to speak of the better quality of the goods, the more marketable quality of the goods, or whether it means the expense of making the goods. There is no question in my mind, with what experience I have had, which has been rather limited with frame filling, but that we can make the goods cheaper with frame filling than we can with mule filling, for the reasons that we spin the yarn for less money per pound and we make less waste. But our experience has been on what we call fine and nice goods, that we can get a better appearing and a better selling and a more satisfactory piece of goods from mule filling than we can from warp filling. The reasons for that are various. One of them Mr. BROOKS alluded to in the draft of his condensed yarn. If we spin the filling on a mule it has a long stretch before it is wound on the cop, and the twist naturally runs to the fine place in the filling. If we put a sufficient draft into the mule — most of us put in all that it will possibly bear — if there is a coarse place in the filling, that is the place that the draft will take out. We get a much more uniform thread than we can possibly get on a frame, thereby giving us a more uniform twist to the goods. I presume that for print cloths and all coarser goods the difference will hardly be noticed; that perhaps there would be no appreciable difference in the selling of the goods. But we have felt that for making fine goods, goods that were liable to come to close inspection and goods in which there was sharp competition, we could give our customers better satisfaction with goods made from filling made on mules than we could from filling made on frames. I really am not prepared to give perhaps all the reasons that I could have done had I

had a little more time before I "warmed up," but I should really, in making fine goods, give the mule the preference, if we are going to allude to the quality of the goods after manufacture. While I am satisfied that it would cost something more to make them, I am satisfied that the quality of the goods will more than compensate for the cost. At least, such has been our experience or prejudice.

Mr. WILLIAM J. KENT. Mr. President, I think it is time for me to speak on this subject, as I have suggested it, and there does not seem to be anybody that understands it. It reads, "Can as marketable goods be made from frame yarn as from mule yarns?" Now, what I meant by that was, not only what the selling house think of it, but will the converter accept the piece of any style as quickly made from frame filling, as he will from mule? It has been my experience that if you put two pieces of cloth on a table, one made from mule filling and the other from frame, and not know which is which, you will invariably pick out the frame filling as the best. I was in hopes, when I suggested this subject, that some of the members of this Association who have had large experience in this filling out branch would be here to discuss it, especially one of the Board of Government, Mr. HENRY T. WHITIN. Now he has tested this very thoroughly, I think as high as 60s; and then at another mill, which is a neighbor of mine, they have tested it up as high as 80s and 100s, and invariably they have picked out, without anything to show which was which, so that they would have no prejudice whatever — they have picked out the frame filling as the best goods. Now Mr. WHITIN has been so far as to take a bale of each and send it to the bleachery and not let the buyer know which was which, and then send it on and ask him which he preferred. Sometimes the party has said it would make no difference; other times he would pick out the mule filling and other times the frame. So it shows if the filling is properly spun you can get just as good results from mule as you can from frame. And my experience is that yarn can be spun on frames twenty per cent. cheaper than it is on mules.

Mr. ARTHUR H. GULLIVER. After hearing what Mr. KENT says it rather changes the condition of the question in my mind; and I would like to say that we have had a good deal of experience on spinning frame filling within a few months. We went into it with the expectation that we were going to have a little trouble with the goods; but when we had the yarn spun and goods woven and sent to the bleachery we found, as Mr. KENT said just now, that the goods that were finished on frame filling were the best goods that we had in the bleachery. Now, that was nothing to do with the question that I spoke of, in regard to the filling being rough in the unbleached goods. There is no question in the world, in my mind, that you could distinguish the mule filling and the frame filling in some numbers of yarns and on the same quality of goods if you see them every day. But so far as the goods go there is no question at all that the handsomest piece of goods, in the opinion of the foreman of the bleachery, was the one where the filling was spun on the frame. I could not say why it is so, I could not explain it, unless I had the goods here for you to see with your own eyes, but that is the case with the goods that we are weaving with number 36 frame filling. But the goods certainly have a very fine appearance, one that is very pleasing to those who are interested in and have advocated frame filling in place of mule.

Mr. LOUIS SIMPSON. Mr. President, I would like to ask Mr. KENT if he has had any of his goods dyed as well as bleached, because it might be possible that although the goods made on ring filling would bleach well, yet they might not dye well.

Mr. WILLIAM J. KENT. I would say in reply to the question that I have had no experience with colors, but a mill that was a neighbor of mine had; they had been into it very thoroughly. I claim that the reason that mule filling is inferior to the frame is the very reason Mr. KNIGHT spoke of. He told you that the twist on a mule, owing to the long stretch of 64 inches, generally would run into the fine places. Now, as a general thing that does not run into the fine places on a frame, so that you do not have — for instance, in the case of a very fine sateen, where it

comes as high as 96 by 250, you do not have those soft, fleecy places, but the surface of your goods is uniform, more so than it is with the mule filling.

Mr. LOUIS SIMPSON. For the information of the members I would say that, so far as I am aware, all the sateens made in England and in France are made from mule filling. I have been making sateens for twenty years back, and I have always made them from mule filling. As to coarse sateens, I am just putting in some frames now—I hope to have them at work next year — when I am going to attempt to make coarse sateens from frame filling. But I have been a bit nervous in my own mind, whether when so made they would take the dye, the aniline dye especially, as well as they would if made from mule filling.

Mr. WILLIAM J. KENT. I would suggest that if you are going into that business, that you do not have an excessive draft on your frame. As a general thing the shorter the draft the better. Manufacturers are not willing to take 10 or 20 per cent. saving but want 30; they go to work, put in coarse roving, draw it down because it costs less, and then they condemn the goods on that account. Give the yarns a fair show, and the goods will come out all right.

Mr. THOMAS MAYOR. My experience is that up to 80s you can get as nice yarn on a frame as you can on a mule, with the proportions of the ring according to the diameter of the bobbin. My experiments in Pawtucket ran along for some six or eight weeks and went all the way from 40s up to 110s, and the twist was always the same as the mule. I had the overseer of the mule room in the mill come in every about day and try to pick out his cops from my ring yarn. The result was, when I had them in my hand he could see where the yarn came from, and he would say, "Oh, well, I can pick them out every time." I said, "I can't see it." And as I say, I have made that a study for a great many years. I said, "Now, Mr. Overseer, it isn't any use for you to tell me; I will fix this before to-morrow so that I will defy you or any other mule spinner that ever went into the mule

alley to pick out that yarn." I got a box that window glass came in; I partitioned it off and put three bobbins that I had made and three of his cops into it; took a piece of wood and marked it out just the length of the stretch. I said, "Now, Mr. Overseer, I would like to have you pick out your yarn to-day." Well, he went at it; put one thread on one finger and another on another finger and another on another. He took two of bobbins and one of mule. Now mark what I say, that I have been satisfied for a great many years that we can make as nice yarns up to 80s and make it fast, as we can on any other machine with the ring frames built as they are to-day, when the proper proportions are put in that way. I was brought up in a mill and have been working upon these problems up to the present time with a great deal of pride. I say we can make frame filling up to 80s with the same twist as a mule, and nobody can pick it out when proper roving is put in.

Mr. STEPHEN A. KNIGHT. Mr. President, I prefaced my remarks by saying that I was satisfied the goods could be made cheaper — no question about that, for the reason that we can spin for less and make less waste with frame filling than we can with mule filling — and I also prefaced, or intended to preface, my remarks by saying that my experience had been very limited with the frame filling, and perhaps one of the great faults with us is that what little frame filling we have used we have usually made from the same roving that we would make if we were to make it on the mule, which has been a long draft; and, perhaps, had we all frame spinning, we should have adapted our roving to the proper draft and perhaps might have gotten as good results as we have gotten on the mule. But with our experience we have been compelled to twist harder on the frame than we have on the mule, and it has given our goods a wiry appearance that the consumer, the converter has noticed, and criticised unfavorably, and some of them have gone so far as to reject goods from certain mills from the fact that some part of the cloth in those mills was made from frame filling. Now, I would not like to be understood to say that it is not

practical, and perhaps that it is not a fact, that under proper conditions the frame filling may make as smooth and as saleable goods as that made from mule filling. But I only speak from the experience that we have had ourselves in the matter, that under the disadvantages that we have for frame filling we have not gotten as even a thread; we have had more bunches in it, it has been harder twisted and given the cloth a harsher appearance and a more unsatisfactory appearance to the converter, than has been the case with the mule filling. But I would not like to say — in fact, I do believe that the time is not very far distant when frames will almost entirely supplant the use of mules, because we can do it for very much less, and we have learned to spin with very much less twist on the frame than formerly, and we are an advancing people and I have no doubt the time will come when we shall twist all right. Perhaps when Mr. DRAPER gives us his paper on rings and we learn all about the application of the traveler to that ring, we may get at some points which will lead us to reject the mule at once. I should be glad if that could be the case, because I know it would be a great saving in the cost of the goods. But the fact has been that a certain portion of our customers — and those are the converters, people that make fine goods to put on the market — have not been as well satisfied with the goods that we have made from frame filling as they have with the mule.

The PRESIDENT. As the question seems to be as to the marketableness of the goods, it would seem to me that the question might be, supposing the buyer knew that goods were made of mule and frame filling, which would he prefer? Supdose that the buyer knew that the goods were made of mule filling or frame filling, which would he prefer?

Mr. THOMAS MAYOR. There is a great deal of prejudice today which enters into the question.

Mr. STEPHEN A. KNIGHT. I put my statements decidedly on the ground that we knew and he did not, and the goods that he complained of were goods that we made on frame filling.

Mr. CHARLES W. DENNETT. Mr. President, referring to the

question of the difference between the coloring of goods made of frame filling or mule filling, what experience I have had in that direction is substantially this: There is more difference in the appearance of a piece of goods after it is dyed due to variations in weaving, than to variation in the kind of filling, whether it is mule or frame. If the frame filling is a little harder twisted, and the dyer understands about it, he can arrange that in his process. But if there is a variation in the tightness of the warp in weaving, if one warp is tight and another is slack, the difference will appear in the piece-dyed goods; it will appear very sensibly. And I have noticed from my experience in overlooking such goods, much more difference coming from the weaving than in the difference between the mule and frame filling.

Mr. ARIEL C. THOMAS. We have used at the Clinton Manufacturing Company, in making their goods for over twenty years, both frame and mule filling yarn, and I cannot find any difference. The numbers that have been made are 28, 30, 32, 36, 40 and 42.

The PRESIDENT. Will any other member add his experience? If not, we will take up the next topical question, 76, "What are the best means to prevent waste of all kinds in a mill?" This question is a very broad one and was suggested by Mr. KENT, whom I will call upon to open the discussion.

Mr. WILLIAM J. KENT. You evidently see the President means to get my share of the work out of me. I will commence my remarks on that question by a comparison. The fellow that suggested this subject takes a great deal of care of his wife's husband. He watches him early and late, takes care that he does not eat anything that will hurt him, or that he does not drink — much. (Laughter.) That is just the thing you have got to do with the waste business in a mill. In my recent trip abroad I investigated this subject quite thoroughly, and it grieved me very much on my return to pass through the various

mills which I have charge of and to see the immense amount of waste that was made. It is painful, after you have passed through so many mills as I did on the other side of the water, and have seen how little waste they make, and the question arose with me, Now, what is the best way to get that waste down? I have talked with the superintendent and the mill overseer, and the question arose whether I had not better have meetings once in so often of the superintendents and overseers, and give them lectures on the subject, and see if we could not together contrive some way to bring this down to the minimum. I was in some mills on the other side where they turn out more pounds of yarn and get dollars and cents for it than they put cotton into the mill — bags, hoops and all. (Laughter.) Now, when we figure up our waste, which is very large, and amounts to 27 per cent. gross, because we have a large number of combers, and after we sell it and figure it over and find that the net is over 16½ per cent.; we used to think that was pretty low, but I do not think so now. I have come to the conclusion that it ought to be less, and I have got to labor every hour of the day that I can to get it down. And my idea was in bringing that before the Association that I might get some information from the members in regard to it. You can follow it very closely trom the time the cotton goes into your picker room. You can keep track of how your bags are picked, what waste is made from the drawing, and so on clear through — you can handle it very carefully until you come to the weaving. And I found on the other side that they experienced the same trouble there that we had when I was in Fall River managing a mill there. It grieved me one day to see the waste that was made, and I made a hue and cry over it and indulged in some pretty loud talk and supposed I was doing some good. The next week I had more. And so I went on trying every experiment, and I found that if they did not leave us the waste, they took it home in their dinner pails, and you would find it deposited over the fence, and some in the school yard. Therefore, when I was on the other side I was particularly interested in going through

some of the weave rooms to ask how they governed the waste made by the weaver. "Do you do it by making your cops nice, so as to weave off nicely?" And they said they did it mostly by keeping still. I went into a weave shed—you know there are very few people there who spin and weave their own yarns—and in this particular weave shed I noticed quite a quantity of waste in a bag, greater than I anticipated seeing. I remarked, "Why, you do make some waste this side of the water." "Oh, yes," the overseer said, "there is quite a large quantity." "How do you get it down?" "The only way we get it down is to keep quiet. If we go for the weavers and tell them they are making too much waste, we are apt to get more." So I hope you gentlemen will give me some ideas on this matter that will help me, because I want to get my waste down a good deal lower than it is.

Mr. STEPHEN A. KNIGHT. I would like to ask Mr. KENT if the mill that he saw where they sold as many pounds of yarn or more than they bought of cotton—whether they sold any bags and hoops, or did they put them all into the goods? I want to learn the method. (Laughter.)

Mr. WILLIAM J. KENT. As to that question, I would say that I did not see any machinery over there that would spin the hoops or the bags. Those are sold, of course, and the proceeds are deducted from the gross waste, the same as in this country, and the money is put into new cotton, and that goes to the credit of the waste. But they have processes over there which are peculiar to them alone, and peculiar somewhat to their trade. We could not practice a good many of the methods which they have there, coming as we do so closely in contact with our customers, especially in the Association, where we get up and tell so much about what we do; we could not do that. Now, our President is one of the largest yarn buyers in Massachusetts; he is a good customer of mine. It would be very foolish of me to get up here and tell him how I made his yarn. If my price is satisfactory and I give him good yarn, that is all he ought to know about it.

The PRESIDENT. I will state that I don't care for anything more than that.

Mr. STEPHEN A. KNIGHT. I only wanted to know how to incorporate the bags and hoops into my yarn. I haven't been able to do it yet.

The PRESIDENT. I never have found any bags and hoops spun into our yarn that we have received from Mr. KENT, but perhaps I had better not tell all that we have found. (Laughter.)

Mr. WILLIAM J. KENT. Well, I wouldn't. We will settle that outside.

Mr. CHARLES W. DENNETT. Mr. President, there are a great many things that are discussed here in the Association that I do not feel competent to say anything about; I listen and learn all that I can. Perhaps my experience on the waste question, especially after the cotton has gotten into the yarn, has been quite extensive, and in a general way I will say that I have been able, both when I was an overseer and since I became a manager — and I have followed the same course with my overseers that I formerly pursued myself in that capacity — to reduce the waste by making every person that handled the yarn feel his or her individual responsibility as much as possible. For instance, take it in colored spooling. I went to a place once where there was an immense amount of waste, to take charge as overseer, and I went to work to get right down fine just what every hand did. The yarn was weighed out to them and their waste was weighed when they returned it. We did not wait until noon time or night time and take what was made during the forenoon and afternoon, but as fast as a bundle was spooled the waste was carried back to the one whose duty it was to weigh it, and it was carefully followed in that way. And whenever any hands were evidently making a great deal of waste they were called up. The yarn was weighed before and after they spooled it, and when we found they were hiding it, as Mr. KENT says, and carrying it out, when between the yarn that was weighed and the yarn that was spooled there were a good many ounces missing, the girl was discharged without any question. I always

discharged them, no matter how much they plead or how much they cried; they had to go, because it was evidently something that was done on purpose. They have a fashion when the yarn breaks toward the end of a skein, of breaking that skein off and rolling it up, and when each one does that it makes an enormous amount of waste. I reduced the waste enough in that department to more than pay my salary as overseer, and I followed it closely, having the percentage of waste that each girl made in the week figured out in comparison with what she had done before. And I have followed the same plan in the weave room, especially where we have expensive yarns, giving the weavers enough to make a piece and they did not get any more until their waste was returned. The overseers look out for it and see that it is right. Very much in the matter of waste depends upon the care of the overseer in looking after it. He must not simply tell a boy to do it, and then when you come to figure the waste you come down in the last analysis to depending upon what some boy says, but the overseer must know for himself. I believe as a general rule the nearer you can make the individuals responsible for what they do, having them understand that the overseer or the manager knows just what they are doing, and making it a personal matter with every one, the nearer you will come to solving this question of waste, which is one of the most vexatious and difficult troubles in the mill.

Mr. WILLIAM J. KENT. I do hope for my sake that more of the members will give us their experience on this matter. It makes a great difference in our account whether the waste is ten, fifteen or twenty per cent., and I wish you would talk about it.

Mr. STEPHEN A. KNIGHT. The question proposed by Mr. KENT strikes me as a very broad question, almost as broad as the fields where the cotton is raised. It is a vital question also. The quantity of waste we make has much to do with the balance sheet at the end of the year. This question was talked about by the Board of Government before it was presented here, and it was suggested there that the way to make

the lowest possible amount of waste would be to stop the mills, and I presume that would really be the fact. If we should shut down, we should stop the waste. But the remedy, it strikes me, is not altogether in weighing the waste. I have tried it. I have been in the mill quite a long time and have learned that that is one of the features of the business; that we want to get as many pounds of goods out of a bale of cotton as we can, and I have learned that it does not always answer to depend upon the pounds of waste that we pick up from any special hand and weigh it, and say that he or she made it. If we had a method of weighing the yarn that they consume rather than the waste that they give us, we should know more about it. I have tried various methods; we have adopted the fining system, and the discharging system, and persuasion, and almost everything else; and I have found that whenever we have brought the rule down too fine it would be a fact that the waste would decrease, so far as what was found by the overseer or those whose duty it was to pick it up, but I have learned at the same time that the tin peddlers bought more waste than rags, but bought it as rags, and that families consumed less shavings in kindling their fires than they did when we did not press that question so hard. So I believe there is such a thing as pressing the system too hard, and in saying how many pounds to the loom there shall be. There is a limit to that. I believe that the real solution of the matter, so far as the waste in yarn is concerned, is to make better yarn. If we make our yarn near enough to perfection so that we have but little breakage in it, if we make our filling so as to avoid breakage, there is no occasion for so much waste. And while it is an excellent thing to look after the careless habits of the help that handle the yarn, I believe there is more in looking after the small details of the manufacture and to the perfection with which the yarn is passed to the various hands, than there is in weighing the waste which they make. It strikes me that the great lack to-day in our mills and a great many mills that I have visited, is the lack in looking after the little things. It is the tail ends that make the difference, both with

waste and almost all other parts of the manufacture. It is an old adage that if we look after the pennies the dollars will take care of themselves, and I feel that that applies very nicely to the manufacture of cotton goods. If we look after the little affairs, all the small details, keep them in mind all the time, we shall have but a very few large things to look after. And so I believe about the waste, that the better we card, the better we spin, the better we spool, the better we handle our cotton all the way through, the less waste we shall get, while at the same time it is quite necessary to hold in the lavish use of perfect yarn.

Mr. WILLIAM J. KENT. There is another part of the subject which I had hoped some of you would speak upon, but as no one has done so I will try to draw them out. I notice on the other side of the water, in fact, I did not see a mill where they allowed their machinery to be cleaned with cotton waste, not one of them. Now, you can pass through scarcely a mill in this country, or at least I never have, but what you will see a profusion of waste in the various parts. You can go into my engine room to-day and you will see up in the corner a box gotten up very neatly which contains cotton waste for cleaning purposes. There is a tremendous amount of waste so used that ought to be in cloth. It is there, and it is an eyesore. I noticed in mills on the other side, especially in England, they would not allow them to use waste for this purpose, but they use silk wipers, and at the end of the week those are collected and deposited in a bag and sent to the laundry to be cleansed, and then they are returned. There must be economy in that, or I do not think they would have done it. Some years ago I remember that that system was tried in this country. I never went into it very extensively and I am sorry now that I did not, and I would like to ask if there is any member of the Association that has tried it, and if so, what was the result?

Mr. LOUIS SIMPSON. I can answer that question. I used those wipers many years. I am very sorry I cannot use them now. We had to pay so much for the wipers at first, and a

man was sent around every week for the dirty wipers and brought them back the following week clean, and he kept the quantity that we had in use always at the same number; that is to say, if he found any worn out he replaced them, and I understand that the man made a fortune on the oil that he got from the wipers. I do not know how he did it, but he must have been very careful and ingenious. I do not think that Mr. KENT need feel so very badly about his experience on waste. I have no doubt that he, like all of us, feels that he has more waste than he ought to have, but at the same time I feel that he has not been quite fully informed about the methods used in England where they turn out as much yarn as they buy cotton. Perhaps it is not well known to the members of the Association that in England they do not buy cotton the same as we buy it here; they buy cotton less tare and bands. That is to say, the bales are weighed in Liverpool, and at the scale the merchant allows two pounds per bale for draft, which you are aware, we do not get here. Generally our bales come a trifle on the short side instead of on the long side. And after that they take out four per cent. for tare and about two per cent. for hooks. This makes a great deal of difference. After the yarn has gone through the mill they have a nice cool warehouse, generally in the foundations of the mill, down in the bowels of the earth, where they have water flowing on the floor all the time, and they leave the yarn there for a week, and if their customers are in a great hurry for the yarn they do not hesitate to take the garden hose and sprinkle it very liberally. In fact, one spinner, who has gone to his last account now, always used to go to the warehouse on Sunday, and while he was using the garden hose he would sing the hymn, "Praise God from whom all blessings flow." (Laughter.) You understand when you start with six per cent. allowance on your cotton bales, and four to five per cent. gain, according to your conscience, on your finished yarn, it makes a good deal of difference. But I think if all the members of the Association were to make a rule of having their waste weighed from their spoolers every day, which is a very usual custom in England, they would find it would

be of use to them, especially as Mr. KNIGHT has very well said, if they are not too hard upon your help; but at the same time, weighing your yarn and being easy, as Mr. KENT'S friends told him in England, you come to know who is robbing you, and then, of course, if you know, you will give it to those people in a "quiet sort of a way". In the weave room I believe in making every fixer collect the waste from his weavers, and in the same way it is his place to know if any weaver is making waste in excess of the reasonable quantity, and then it is his duty to report to the boss weaver, who in my system pays special attention to that weaver, and when the weaver is caught spoiling the yarn, then the best thing is to replace him. But I would like to ask Mr. KENT a question. Did he hear from his friends in England when he was there what they considered to be the legitimate waste in their filling? It is sometime since I was in England, and I would like to know for my own information in case he heard.

Mr. WILLIAM J. KENT. I will answer the gentleman by saying that I was fully aware that the English factories bought their cotton in the way which he states. I am also aware that a good deal of that net weight goes into the price that they pay for the cotton. And I have visited a great many of those places where God's blessing flows, and seen the process of the blessing. But I have no figures to show the exact waste made in the weave rooms, and I do not think it would compare with any of ours if I had, for the reason that you are well aware that a great many of the weave sheds over there weave a great many varieties of goods under one roof, and therefore the comparison would not be of any value to us. But I looked at the number of looms and the quality of goods they were manufacturing, and the number of yards, and then looked at the waste they made, and it was very small. But the fact that they did not allow their help to come any of this funny business in the card room or any other part of the mill struck me very forcibly, and I wanted to profit by all the points I could get, and consequently I am on

the warpath now, not only for waste but for a great many other things.

Mr. LOUIS SIMPSON. I would like, then, to say that when I was in England, if you were using filling yarn from 30s up to 50s, anything under four per cent. waste was considered all right; if you get down to 3½ per cent. it was very good. From 3¾ to 4 per cent. was considered the correct thing. When they are using coarser yarns, which are usually spun soft, the percentage may go up to 5 per cent., but on average counts 3½ per cent. is good.

The PRESIDENT. I would like to say in reply to Mr. KENT, that I am very glad that he proposes to reduce his waste account instead of adopting the English method of using the garden hose.

Mr. LOUIS SIMPSON. I thought you would know.

Mr. CHARLES W. DENNETT. If you will allow me, Mr. President, to add one word more in reference to the various systems for overcoming these difficulties: it takes a man with some sense to administer any system, and with some overseers the only way to do is to let them go on the outside. I was in one mill where we had a great deal of waste from broken bobbins. The yarn apparently was put on broken bobbins. The spinner insisted that the spooler or the reeler broke the bobbins. I adopted this system: I had the bobbins all picked over after the spooler or the reeler and sent nothing up to the spinning room but sound bobbins. They kept coming down broken, and I located the trouble in the spinning room. As to the methods of handling the spooling, I would never allow a girl to take any yarn off a bobbin for any cause; she must not cut it off and she must not pull it off. If she could not spool it she must put it in a box. I had those bobbins counted every day from every spooler. Now, it would not happen that any one spooler would get all the bad bobbins or a large proportion of them, and in that way you would find your bad spoolers; and following it up carefully and with judgment, I believe the waste can be very largely eliminated. It is quite an interesting thing to go through the

mill from the spinner to the cloth and find out what percentage of the whole waste is made in the different operations. I think I have a table of that at home and at some future meeting I shall be able to present it.

The PRESIDENT. Perhaps Mr. DENNETT would submit it in connection with this discussion and have it printed with the records. That would make it more interesting.

Mr. CHARLES W. DENNETT. I will try to.

Mr. WILLIAM J. KENT. Well, Mr. President, this whole discussion resolves itself into eternal vigilance, does it not?

Mr. STEPHEN A. KNIGHT. That is the size of it; that is the price of success.

The PRESIDENT. As a weaver I would say that we find it is sometimes necessary to reduce the waste by changing spinners. (Laughter.)

Mr. WILLIAM J. KENT. You have got that on me once more.

Mr. GEORGE F. WHITTEN. This subject addresses itself to the manufacturer with especial importance and is constantly demanding the attention of a successful management. Of course, as a general proposition, it may be stated that the better running of the work will minimize waste of all kinds. It is essential that every picker lap should be even and that iron lap rods should be used; in addition to this, there should be a sufficient number of lap racks, thereby preventing the piling of laps on the floor. The speed of 36-inch card cylinders should not exceed 125 revolutions. We should have the drawing evenly distributed on the railway aprons, both breakers and finishers. The railway heads and drawing frames should be provided with metallic rolls and plungers (when coilers are not used); the stop motions should be kept in good working order, so as to prevent the ends from passing through the rolls as the back cans empty. When the cans at back of the slubber are nearly emptied, I would break the ends back and splice them at the drawing frame at the time full cans are removed, instead of tipping them out to be put in a full can. For all roving frames we should have taper enough on the bobbins to prevent snarling and adjust

everything connected with change and rail motions, so as to act free. I suppose the amount of waste made in creeling would vary with the number of spindles a hand tends; an overseer who takes any interest in his work can and would prevent any excess in these places. For spooling, warping and dressing — with spools 6 inches by 4¼ inches, with warper beams having a 25-inch head and with the number of ends from 300 to 320 per beam, we could warp 35,000 yards for numbers 28; with a compression roll on the slashers 15 to 20 per cent. more yarn can be added. In weaving where mule filling is used, in my opinion much waste is made by steaming, caused, perhaps, through the carelessness of those who attend to this, would it not be better to have a damp room in the basement, with a sufficient quantity on hand, say two or three days' supply? and in this way would we not have less stabbed cops and stained filling? If we should provide a sufficient number of filling boxes and thereby avoid the use of packing cases, we would not disturb the filling; otherwise the filling is liable to be mutilated.

The PRESIDENT. The next is a paper prepared by Mr. JOSEPH NASMITH of Manchester, England, whom you will all remember as having before favored us with contributions, and the paper will be presented by the Secretary in the absence of the author.

DIFFERENTIAL MOTIONS FOR SPINNING MACHINES.

JOSEPH NASMITH, Manchester, England.

There are probably no parts of cotton machinery which are more interesting than those which are intended to produce a differential velocity of some moving part. The phrase "differential motion" has come to be associated more particularly with the mechanism used in connection with speed frames. As will be shown, however, this is not the only use of motions of this character in connection with spinning machines. A differential motion may be defined as an arrangement of mechanism which transmits the rotation of a part moving at a uniform velocity to another part which is given a velocity continuously or successively varied. It will be seen that a motion of this character is necessary in all cases where the rotation of the final part is utilized in order to wind upon surfaces of different diameters a uniform length of material or where the velocity of the final moving part is utilized to deliver a greater or lesser length of material according to its substance or thickness. The problem, therefore, is many sided. It may be, as in the speed frame, that a complete layer of a certain length is wound before any change of velocity takes place; or it may be, as in the mule, that during the winding of one length this change of velocity must be continually occurring. Whatever be the operation, in principle it is alike and the character of the rotation of the final part in the instrument employed depends entirely upon the character of the operation.

It is hardly necessary to point out the special necessities in the case of speed frames. Beginning by winding a uniform

length of roving upon a bobbin of fixed diameter the same length of roving has to be wound with equal tightness upon a surface of larger diameter. This formation exists throughout the whole of the building of the bobbin, and it follows that, inasmuch as winding takes place in consequence of the excess of speed of the bobbin over the flyers to an extent sufficient to take up a length of roving delivered, it is necessary at all times to keep the surface velocity of the bobbin in a fixed relation to the surface velocity of the flyer eye in its rotation. Thus means must be provided by which this velocity is decreased and the well known differential, equating, or jack motion has been the instrument usually employed for this purpose. During recent years there have been many attempts made to overcome the difficulties which attend the use of the Holdsworth motion, and it is the purpose of this paper to describe and to some extent to analyze the action of these newer motions with a view of making clear the principle upon which they rest. Not only will this be done, but the similarity between this operation and the operation of winding on the mule will also be pointed out.

Differential motions belong to that species of motions which are known in mechanics as epicyclic trains, and which consist of two wheels geared together by carriers, borne by an arm which revolves on a common centre with the driving wheel during the rotation of the driving and driven wheels. In the special case shown in Fig. 1, the wheel B fixed on the "jack" shaft drives by the intervention of carrier wheels C E, the wheel D loose upon the same shaft and compounded with the wheel N, which is either cast in one piece with it or fastened on its boss. It is now customary to provide a tube surrounding the "jack" shaft on which the wheels L and D N revolve. By shelling out the tube and providing special means of lubrication the friction of the shaft is much reduced. The carrier wheels C E are borne by studs fixed in the arms of the wheel L, and are free to revolve thereon. Thus they have a rotatory motion upon their axes and are simultaneously carried round the orbit of the wheel L as it is revolved. The motion of these parts produces a very

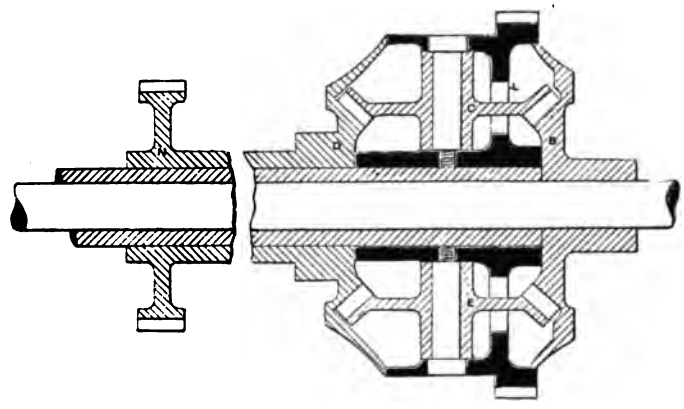

FIG. 1.

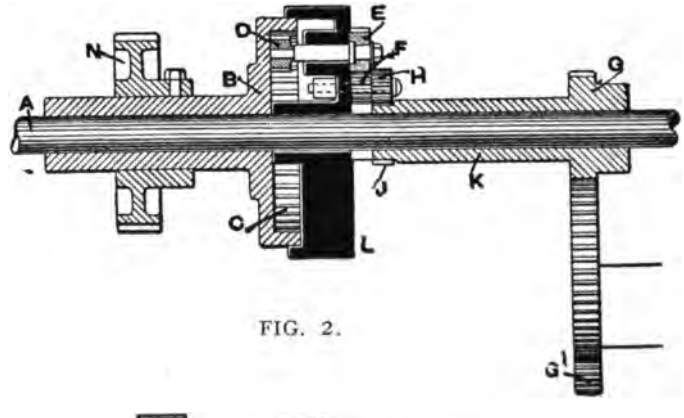

FIG. 2.

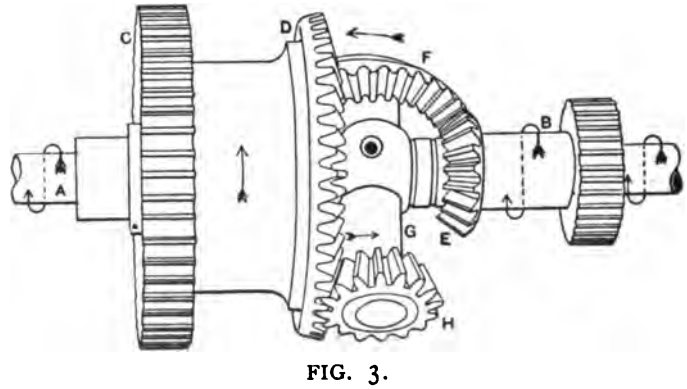

FIG. 3.

remarkable result in practice, and as it is often only imperfectly understood a full explanation is given. If the pinions C E were mounted on centres which were stationary, the rotation of the wheel B would cause D to revolve at the same speed in the contrary direction. If now the wheel L is revolved in the same direction as L and at an equal velocity, the whole of the wheels will be locked and D be carried round at the same speed as B. If, however, the wheel L rotates at a lower speed than B, but still in the same direction, then for every revolution of L the wheel D will lose two revolutions as compared with B. Thus in practice a curious result is produced. When the velocity of L is half that of B and its direction of rotation the same, the motion of D entirely ceases. As the velocity of L still further decreases the velocity of D increases, but its direction or rotation is reversed. Thus what happens is, that if the velocity of L is either more or less than half that of B, its direction of rotation being the same, the velocity of D is increased but the direction of its motion is altered — that is to say, the central point is a zero, and there is a gradual acceleration until either of the poles, as they may be called, are reached. Thus if L revolves in the same direction as B and makes more than half the number of revolutions as B, then the wheel D will move in the same direction as B at a constantly accelerating velocity, as the speed of L and B approximate to one another. If, on the other hand, L rotates at less than half the speed of B, then there will be a constantly accelerated velocity as the speed of L is decreased, but the direction of the rotation of D will be reversed. It may be convenient to give the formula ordinarily employed to calculate the value of this class of wheel train. It is $n = 2a - m$, where n = the number of revolutions of the last wheel D, m = the number of revolutions of the first wheel B, and a = the number of revolutions of the stud wheel L. Thus if $m = 300$ and $a = 150$, then $n = 2(150) - 300 = 0$. If $m = 300$ and $a = 100$, then $n = 2(100) - 300 = -100$, indicating that D is revolving 100 times per minute in the opposite direction to B. If $m = 300$ and $a = 200$, then $n = 2(200) - 300 = 100$, or in other words, D and

B are revolving in the same direction at that speed. Now if the wheel L revolves in the opposite direction to B quite a different state of things arises, for the formula then becomes $n = -2a - m$, the quantity a having, by the reversal of the movement of L, becomes a minus quantity. Then the equations become as follows, when (1) the wheel L is stationary, (2) when it revolves at half the speed of B, and (3) when it revolves at the same speed as B, but all in the opposite direction: (1) $n = -2(0) - 300 = -300$; (2) $n = -(150) - 300 = -600$; (3) $n = -2(300) - 300 = -900$. In other words, the velocity of the wheel D steadily increases with the increase in the speed of L, but the direction of its motion is in all cases the reverse of that of B. This fact has an important bearing upon the working of the motion, because it enables an equal velocity of the wheel D to be got with a slower speed of the wheel B. Further, when the bobbin leads it is possible to commence the operation with a comparatively moderate speed of the wheel L, and to still further reduce it as the bobbin fills and requires a smaller circumferential speed. Thus we arrive at the conclusion that when the flyer leads it is better to run the wheel L in the same direction as B and gradually diminish the velocity of D. From the point of view of wear and tear, there is no comparison in the merits of the two systems.

In the differential motion constructed as described it is necessary to use bevel wheels to transmit the motion of the driving pinion to the bobbin wheel. It is also requisite for the wheels to revolve in the opposite direction to the shaft, and when they are borne directly by the shaft this gives rise to a good deal of friction. Accordingly, it has been thought desirable to design differential motions by which the same effect is obtained without the evils ordinarily to the motion. In one motion—Curtis & Rhodes'—the object has been to avoid the use of bevel wheels altogether and use spur wheels only. This motion is shown in Fig. 2, and consists essentially of a disc L, which carries studs, as shown at one part of it. One of these studs has fixed upon it the pinions D and E, and revolves with them. The pinion E

engages with a pinion *F*, compounded with *H*, both of these revolving freely on the second stud. The pinion *H* is meshed with a pinion *J*, formed on the end of a long collar *K*, on the other end of which the wheel *G* is fastened. Thus, the rotation of *G* from the lower cone in like manner rotates the whole train of pinions from *H* to *D*. The latter is geared with an internal rack *C*, formed in the flange of a long bush *B*, rotating on the jack shaft *A* and having fastened on it the bobbin wheel *N*. The wheel *G* has 40 teeth; the pinion *J*, 24; *H*, 28; *F*, 25; *E*, 23; *D*, 14; and *C*, 90. The wheel *G* rotates at 316 revolutions when the belt is on the small end of the cone, a special train of gearing being employed between the cone pinion and *G*. This disc *L* is fast on the shaft, and therefore revolves at 300 revolutions; or, in other words, the wheel *G* revolves at 16 revolutions in excess of *L*. Now the pinion *D* is carried round with the disc, so that it will cause the internal wheel to gain on the disc, and the extent that it gains can be easily calculated by obtaining the value of the train from *J* to *C*, and multiplying it by the excess of revolutions made by the wheel *G* over the disc. This works out thus $16\frac{24\times25\times14}{28\times23\times90}=2.32$. That is, the internal wheel *C* revolves 302.32 times per minute, from which the speed of the bobbins can be easily calculated. It must be clearly understood that the speeds and sizes of wheels, although those actually used in some cases are, so far as the present instance, purely arbitrary, and are simply used to illustrate the method of making the necessary calculations.

Tweedale's motion is illustrated in Fig. 3, and consists of a compound bell wheel *C D* revolving on the shaft *A*, the direction of the motion of the wheels being indicated by the arrows. The wheel *B* is connected with the cones, and is compounded with the pinion *E*, both of these revolving freely upon the shaft. A double boss *G* is fixed on the latter, and carries a short transverse shaft on each end of which respectively the pinions *F* and *H* are fastened. The short shaft passes through a hole in the jack shaft, but the horizontal boss of the arm *G* surrounds the shaft at this point so as fully to maintain its strength. The

pinion E engages with and rotates F, thus giving motion to the pinion H, which drives the wheel D. There is one important point in this motion, which is, that the wheels B, C and D revolve in one direction and at a lower speed than the jack shaft, the speed being gradually diminished as the bobbins fill. This device deserves a full explanation. It belongs to the epicyclic class, but has some points of difference to the ordinary type. It will be seen that the motion given to D is compounded of two, that due to the rotation of the arm G and that to the rotation of the pinion E. Let us assume that G, or the jack shaft on which it is fixed, makes m revolutions. The pinions F and H in their revolution round the axis of A are free to rotate on their own axes, and accordingly, as in the Holdsworth motion, would give rotation to D in the opposite direction to the pinion E at a speed equal to $m\frac{EH}{FD}$. The latter factor represents the value of the train from E to D. If now it be assumed that the arm G is fixed — that is to say, the jack shaft is stationary — then if E makes n turns the speed of the wheel D is $n\frac{EH}{FD}$. The ultimate velocity of the wheel D when both the pinion and shaft revolves is equal either to the sum or difference of the speed given in the two conditions named. Obviously there is, if the jack shaft revolves in one direction and the pinion E in another, an added velocity given to the pinion F and H which would affect the speed of the bobbin wheel, while as clearly if the pinion E and jack shaft revolve in the same direction there is a reduced velocity of F and H. If, therefore, the value of the train $E\ F\ H\ D$ be called r, then the velocity of the wheel D is $V=(m—mr)\pm(nr)$ or by transposition $V=m—r(m\mp n)$.

When the flyer leads the factor in the brackets is $m+n$ for the reason stated; while when the bobbin leads it is $m—n$. The speed of the pinion E is reduced as the bobbin fills when the latter leads and its direction of rotation is the same as the jack shaft. When the flyer leads the speed of the pinion E is increased as the bobbin fills and its direction of motion is reversed. For a bobbin lead, therefore, the formula is $V=m—r(m—n)$, and for a flyer lead $V=m—r(m+n)$.

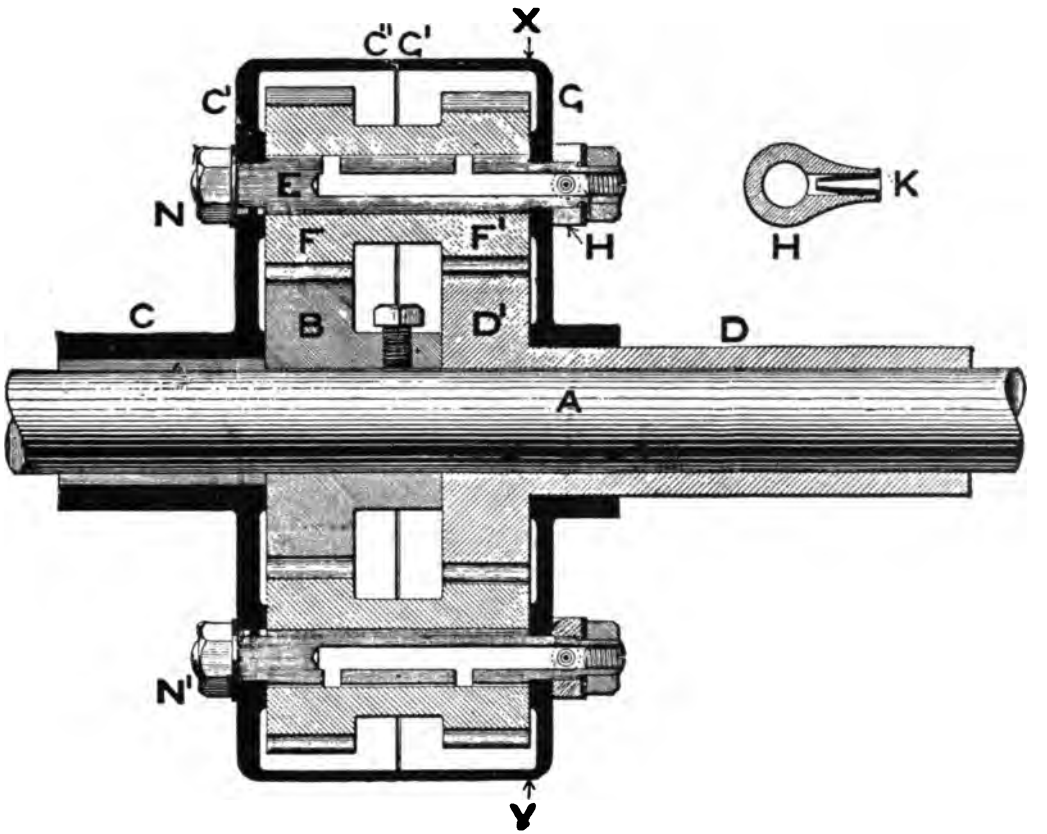

FIG. 4.

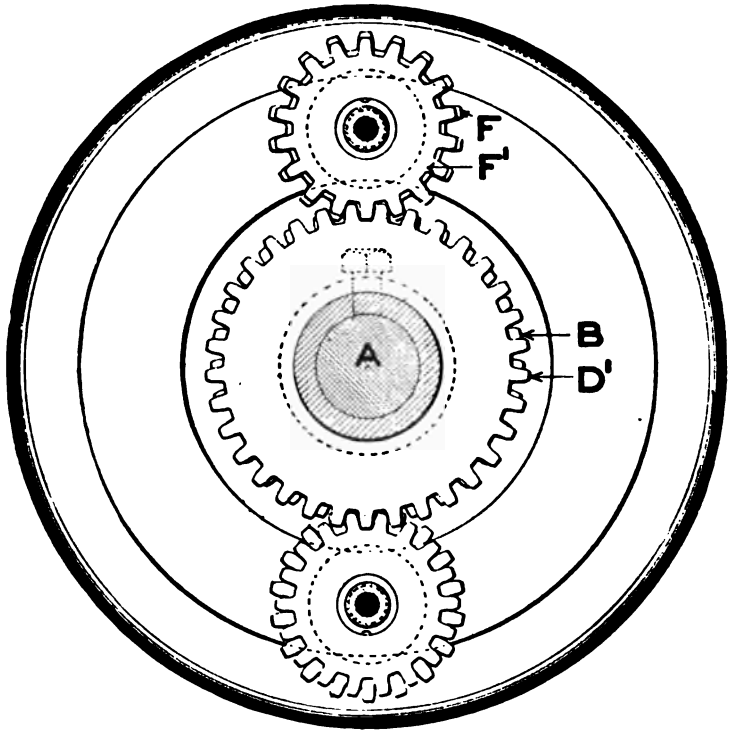

FIG. 5.

The pinion E is made with 18 teeth, H with 16, F with 30, and D with 48. The ratio r is therefore $\frac{18\times16}{30\times48}=\cdot2$. If the revolutions of the jack shaft be assumed to be 300 and of E 260 revolutions then the two formulæ work out as under $V=300-\cdot2(300-260)=292$; $V=300-\cdot2(300+260)=188$.

The chief advantage derivable from the use of this motion is that as all the wheels rotating on the jack shaft run in the same direction as that shaft a considerable amount of friction is saved. The direction in which the wheels F H revolve is indicated by the upper arrow when the flyer leads and by the lower arrow when the bobbin leads. The cross shaft and its attached pinions have an independent motion entirely and their rotation does not affect the friction on the jack shaft, which is an important point. The mechanism is very rigid and runs well, and on the whole this is one of the best of the newer appliances.

Another differential apparatus is Shaw & Brook's which is illustrated in Figs. 4 and 5. The cone pinion is fastened on the boss C of the disc C' which has a flange C''. The latter joins up to the flange G' forming part of the disc G. Both discs revolve freely on the bosses or sleeves shown surrounding the jack shaft and carry pins E, which are secured by nuts. The discs and flanges form a cover for the gearing in addition to acting as the revolving arm. Fixed on the jack shaft A is a pinion B which engages with the pinions F freely rotating on the pivots E and compounded with the pinions F'. The latter, in turn, gear with the wheel D', running loose on the jack shaft and having a long boss D on which the bobbin wheel is fastened. It will be seen that oil ducts are formed in the spindles E, oil being fed by specially contrived oil cups so as to establish in the eyes of the pinions F F' continuous and ample lubrication. In this motion the chief features are, as in the one preceding, a wheel train of which the first member is B and the last one D, and a rotating arm C. The value of the wheel train which forms the first essential feature is $\frac{B}{F}\times\frac{F'}{D'}$. B has uniformly 30 teeth, F and F' each have 18 teeth, while the number of teeth in D' is, in the slubbing frame 37, in the intermediate 35, and in the roving

frame 33. If, therefore, the jack shaft makes m revolutions, the arm C' being stationary, then D' would make $\frac{30}{37}m$, $\frac{30}{35}m$, or $\frac{30}{33}m$ revolutions respectively. The effect of rotating the arm C' is somewhat peculiar. The rotation of the arm once around the shaft A causes the teeth in F to roll over 30 teeth of B. As, during the same time the pinion F must roll round the wheel D', and F F' are fastened together, it follows that unless the wheel D' is moved the whole train would be locked and would rotate at the same speed as the jack shaft. D', being free, can move, and the effect is that if C' has a velocity in excess of that of the jack shaft A the wheel D' must be carried forward during each revolution the number of teeth it has in excess of B. If, on the other hand, the arm C' moves more slowly than A, then in like manner it retards the movement of D'. Putting this into a formula let n=number of revolutions of D', m=number of revolutions of B, a=number of teeth D' has in excess of the teeth in wheel B, b=total number of teeth in D', and c=number of revolutions of C' more or less than those of B. If c be more than m, then $n=m+(\frac{a}{b}c)$ and if c be less than m then $n=m-(\frac{a}{b}c)$. Putting this into figures let $m=250$, $a=7$, $b=37$, $c=250$, (that is, 250 more than m), then $n=250+(\frac{7}{37}250)=297.3$. Now let $c=158.5$, (that is, C' is actually making 91.5 revolutions) then $n=250-(\frac{7}{37}158.5)=250-29.993=220.007$. It is thus possible to get a wide range of regulation with a comparative slight movement of the sleeve C because it is never necessary to rotate it at a higher rate than the wheel B, its movement at an equal rate simply causing all the wheels to roll around together at an equal speed. Taking this point as the zero, the velocity of the bobbin is gradually decreased as it fills by diminishing the speed of the arm C'. This is of course when the bobbin leads, the procedure being reversed when the flyer leads. The wheels all run in the same direction and their speed is small.

Another form of motion is the Dobson shown in Fig. 6. On the jack shaft A are the spindle wheel C, the bobbin wheel N, and the cone wheel G. Also fastened on A is a bevel wheel B

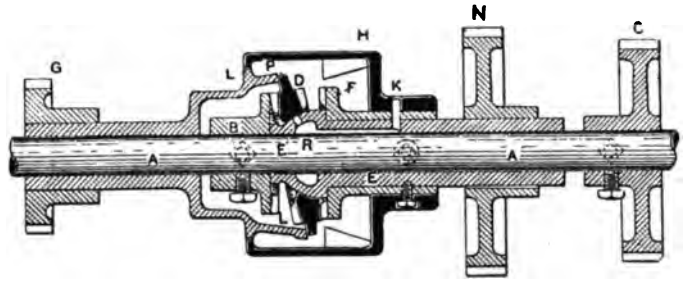

FIG. 6.

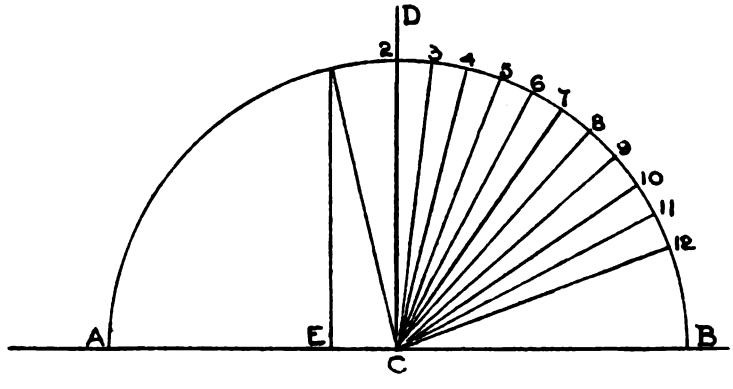

FIG. 7.

which gears with one set of teeth on a double bevel wheel *P*. On the other face of *P* is a second set of teeth *D* which gear with teeth on a wheel *F* which has a long boss and is fastened on a sleeve *E* to which the bobbin wheel *N* is also fixed. At *E'* the sleeve is swelled out into a ball or sphere on which the wheel *P* can revolve. The wheel *P*, as can be clearly seen, forms a sort of clutch between *B* and *F* so that all the parts would rotate together. Working loosely on the shaft is a hollow sleeve *L*, the inner face of which is turned and presses against the face of the wheel *P*. A glance at the illustration will show that the face of *L* is diagonal to the axis of the shaft *A* and that consequently the position occupied by *L* determines the vertical position of the wheel *P*. On the sleeve of *L* the cone wheel *G* is fixed so that *L* is rotated at a speed regulated by the velocity of the driven cone. If *L* makes a complete rotation it will obviously rock *P* on its bearing *E'* and will cause all the teeth of *P* to engage with all the teeth of *B* and *F* in succession. As *C* is larger than *B* in the proportion of 9.8, the result is that *C* is retarded or, in other words, the wheels do not engage successively. *C* thus loses a little speed and instead of driving *S* at a velocity equal to that which on revolution round *B* would give it, drives it at a slower speed. As *N* is compounded with *S* it also — and by it the bobbins — have their speed reduced. By suitably speeding the wheel *C* the necessary variation can be got. It is a peculiarity of this motion that the work of the cam *L* is confined to giving the retardation to the wheel *C* the necessary excess of the bobbin speed over the spindles being in the first instance got by making *N* larger than *C*. By the duct *K* oil is admitted to the chamber *R* and finds its way into the inside of the outer casing, in which it is flung about by the dashers *H*.

It is most important in arranging the wheels in the differential motion, whatever may be its construction, that care should be taken to give the bobbin the correct surface velocity to begin with. That is to say, when the bobbin is empty its velocity must be equal to that of the flyers if the cone drum is stopped.

In this case the only motion given to the bobbin is that derived from the rotation of the fixed wheel on the jack shaft which transmits its motion through the train of wheels. The function of the cones is to give such a variation of speed to the bobbin as will wind on the roving when delivered, and, when the cone belt is in its initial position at one end of the cone, the effect should be to give the bobbin such an amount of acceleration or retardation as will suffice to do this. In some differential motions this essential feature is absent, and cases have come under the notice of the author which demonstrate the importance of the subject. It is sometimes the practice, as with Rhodes' motion, in order to meet the difficulty to provide a larger driving pinion for the bobbins than is used for the spindles, but, although this practice is permissible it is for many reasons inadvisable. What is wanted is a readjustment of the gearing in the differential in order that the proper driving is given to the bobbins. Any other procedure is likely to confuse the users of the machines and more especially those whose duty it is to set and adjust them.

The motions thus described, with one exception, are liable to a reaction in the parts. The differential movement is obtained, as is well known, by regulating the velocity of one member of the wheel trains employed, by means of the traverse of the strap along the speed cones. In the Holdsworth motion the member actuated is the sum wheel L, in all the others it is the wheel on the jack shaft which is geared to the cone. That is to say, in the Curtis-Rhodes it is the wheel G, in Tweedales' it is the wheel E, in Brooks & Shaw's it is the pinion on the sleeve C, and in the Dobson motion it is the pinion G. As all of these have their velocity regulated by the driven cone which is driven by a belt, it follows that it is essential that the latter shall be as free as possible from all undue stress which induces any slip. Every spinner knows the continual difficulty which exists in keeping the belt from slipping on the cones. The demonstration which has been given shows that all these motions are based upon certain mathematical relations existing between the

parts, and it is therefore important that these shall be maintained, so far as possible, intact. It hardly needs pointing out that all wheels and pulleys are simply levers, and that any force applied at their periphery throws stress upon their fulcra. In a wheel train the stress is handed on, so to speak, from member to member until it is taken up by some part which is strong enough to resist it, or until it is dissipated in friction. In the present case the weight is the resistance of the bobbins in rotating, or practically their inertia. This is transmitted through most differential motions until it reaches the point where the belt engages with the driven cone. If the frictional contact here be great enough to offer the requisite resistance there is no trouble; if from any cause it is not, then slip occurs with all the consequent disadvantages. Owing to the existence of accumulations of dirt and grease, which are sometimes permitted to exist, this fault is increased, but with care there ought to be no trouble of this kind.

A duplex system of driving has been sometimes adopted to overcome this difficulty, Messrs. Platt Bros. employing this plan in all cases of heavy driving such as is caused when long frames are used. Two sets of cones are used, the shafts being extended to receive them. The belts are narrower than usual, it being found that they accommodate themselves to the shape of the cones and thus have a better grip although their tension is less. The writer believes that this system has met with considerable success. The motion shown in Fig. 4 meets the difficulty in another way. It is substantially constructed on the principle of the well known Weston pulley block, which easily sustains heavy weights although the chain may be left quite free. In the device shown in Fig. 4 the stress is taken up within the motion and is not transmitted to the wheels beyond it. What is meant is this: if a frame fitted with a differential motion of any other type be employed, and the bobbin driving shaft in the front of the frame be rotated when the driven cone is free, it will be found that the motion of the shaft will be transmitted through the differential motion to the cone. If now the same

test be applied to a frame fitted with the motion in Fig. 4, it will be found impossible to turn the bobbin shaft at all, nor is there any rotation of the arm *C*. This demonstrates the fact that somewhere between the two points there is a part which is offering effective resistance to the force applied. The explanation of this phenomenon is found in the fact that the motion is transmitted through two wheels of unequal size so that the axis of the fixed wheel *B* becomes the fulcrum. The power is expended in the attempt to rotate the wheel *B* and the jack shaft *A* which supplies all the force, and cannot be communicated to the wheel *D'*. The difference in action arises from the relative position of the parts, the wheel receiving the stress being a fixture, instead of, as usually, moveable. By the removal of this factor, the sole function of the cone belt is to rotate the regulating disc *C'* and the pinions *F F'* in the same direction as the jack shaft *A*, which is a comparatively light duty. The importance of this matter lies in the ease with which a belt in moderate tension can be moved along the cones, for upon this immediate change of position depends the adjustment of the various parts to meet the requirements of winding caused by the fresh layer of roving.

A few words may be said on the subject of the cone drums. It has often been asked why the cone drums are of curved outline and not straight. The reason is not far to seek. The governing factors in all winding operations of this nature are the uniform delivery of the material and the variation in the diameter of the bobbin. That is to say, there is an absolute relation always existing between the speed of the bobbin and the velocity of the driven cone. The excess of the bobbin velocity over that of the flyer must be such that its excess surface speed is equal to that of the rollers whatever the diameter at any stage of building. The excess speed which it is necessary to give to the bobbins is therefore the roller delivery in any given time divided by the circumference of the bobbin. The quantities thus arrived at will be found to form a harmonic series, and it will be seen that there is precisely the same result obtained if it

be represented graphically as there is when the expansion of steam is shown by a curve. As pressure and volume are, in the latter case, in inverse relation, so in a roving frame the roller delivery and diameter of the bobbin are in the same relation. In other words the factors are the reciprocal of each other. If, now, the reciprocals of the diameter of the bobbins at any time be ascertained and graphically described it will be found that the curve obtained is a hyperbola. Thus let the length of a cone, say 30 inches, be set out on a straight line and this length be divided into 20 parts. On each of the points so obtained vertical ordinates can be erected. If on these be set out on either side of the central line distances equal to the reciprocals of each bobbin diameter and a curve drawn through the points of intersection, it will be found that this curve is a pure hyperbola. It follows from this that when the cone drums are constructed they must follow the same rule. As the end diameters of cone drums are usually fixed in the proportion of 2 : 1 — although this is not invariable — each intermediate diameter of either cone can be calculated from the following formula. Where X=diameter of driving cone required, d the diameter of large end, d' the diameter of the small end, b the diameter of the empty bobbin and b' the diameter of the bobbin at any given point, then $X=\frac{(d+d')\times d\times b}{bd'x'+d\times b}$. Putting this into figures where $d=7$, $d'=35$, $b=1$, then if b' be assumed to be 1¾ inches diameter the equation works out $X=\frac{(7+3.5)\times 7\times 1}{3.5\times 1.75+7\times 1}=5.6$. Subtracting this from 10.5, the sum of the diameters of the two cones, we get as the diameter of the driven cone 4.9 inches. It is not necessary to labor this, and it is only desired to point out that the necessities of the case arising out of the continuous and uniform increase in the bobbin diameter lead to the construction of drums with the outline described. Unless such a form was given to them there would be an irregular acceleration of diminution of the velocity of the bobbins.

The problem is substantially the same in the scutching machine. Here the feed of the speed roller is regulated in accordance with the thickness of the lap or fleece delivered. These

two factors have an inverse relation that is the speed of the feed roller, which is constant in diameter, is greater or slower in exact proportion to the variation from the normal thickness. That is to say, if the normal thickness be .25 inch and it be increased to .3 inch, the speed of the feed roller must be $\frac{25}{30}$ of its former velocity. Thus, as in this case there is a fixed quantity which forms the basis of comparison and enables a definite ratio to be expressed whatever the variable factor may be, we find by graphically expressing the relation between the two that the hyperbola is again produced. It is true that the changes in the thickness of the material are more rapid than the variation in the bobbin diameter so that the cones are not so long nor the curve so gradual, but it is the same kind of a curve and based on the same law.

Winding on a mule presents precisely the same problem. In the inward run of the carriage after each stretch the yarn is wound upon a surface of decreasing diameter. It is true that each stretch is wound continuously upon all the points of different diameters in succession, whereas in the roving frame a complete layer is wound upon any given diameter and the next layer upon the diameter which succeeds. The principle in each case remains the same and a few words on this will be of interest. It is obvious that at any particular point in the nose of a cop one revolution of the spindle will wind on a definite length of yarn. Thus if a cop be one in diameter and the spindle at the nose of the cop $\frac{3}{16}$ inch diameter the revolutions required to wind on 64 inches of yarn would be respectively 20.4 and 108.55. The upper part of a cop is the frustrum of a cone and it is very easy to calculate the diameters at any particular point. It is not necessary to weight this paper with the demonstration of this point, but what it is desired to show is that if the velocities of the spindle, which are necessary to wind on any defined length of yarn when the latter is being guided on to different points of the cop nose, be ascertained, they will be found to follow the same rule as that shown in connection with the speed frame. In other words, the reciprocals of the diameters again

form the basis of computation, and by drawing a line to a scale representing the stretch, erecting thereon ordinates at equal distances, and dividing the cop nose into a similar number of parts, a curve can be easily obtained which will graphically represent the relative velocity of the cop. The ordinates so erected can be cut at points which represent the number of turns required to wind on any fixed length, or the length wound by one turn. If the points so obtained be joined it will be found that the curve produced is a hyperbola similar to that existing in the case of the roving and scutching machines. This is a noticeable matter and demonstrates the similarity existing in the operation in each case.

But there is yet one other matter which requires notice. As is well known, winding is conducted on a mule by means of a winding quadrant which receives a forward movement in the same direction as the carriage. The quadrant nut to which the chain is attached corresponds to a crank pin and the arm to the crank. The arm of course only moves through a limited space from a little behind the vertical line to a point a few degrees from the horizontal. It is, however, subject to the same laws as a crank pin. Circular motion is a compound of horizontal and vertical motion, and if, in the circle described by the pin, its position be marked off and verticals dropped to the diameter, it will be seen that the horizontal movement is a continually diminishing one. Thus in Fig. 4 the diameter of the circle described by the quadrant nut is represented by AB when the nut is at its furthermost position. $C1$ is the most backward position of the nut and the remaining positions are indicated by the figures 2 to 12. The advance which the nut makes horizontally can be ascertained as follows: Calling the angle $EC1$ a, the radius AC b, and the distance AE c, then $c=b(1-\cos.\ a)$. Under the conditions assumed $AC=30$ in. and the angle a $77°$. The cosine of $77°=·22495$ and the equation works out $c=30-(1-.2249)=30-6.747=23.253$, which is the distance the point 1 when described on the diameter has moved from A towards C. In the same way the successive horizontal advance of the

nut can be calculated, and it will be found that it follows precisely the same rule as the cone drums, decreasing in amount with each equal forward movement of the nut. As the winding drum is revolved by the drawing off of the winding chain it follows that the less the forward advance of the nut the greater the amount of chain unwound and the larger the number of turns of the drum and spindles. If these be calculated and the result graphically described the curve obtained corresponds with that which was got by calculating the number of turns of the spindle required to take up a definite length of yarn. Thus it is seen that the principle underlying the operation is exactly the same whatever machine it be applied to and that all winding is founded upon the same law. In the ring frame the rule does not apply because, by reason of the compensating action of the traveller, the rigidity of the operation is abolished, but wherever there is a fixed mechanical connection between the parts the law which has been briefly laid down holds good.

The PRESIDENT. The next subject is topical question No. 77, "What are the best methods of allowance for depreciation of mill buildings and machinery?"

Mr. J. R. MACCOLL. I think that five per cent. of the original cost of buildings and machinery should be set aside annually for depreciation. Improvements that add to the efficiency of the plant without increasing its size, such as the substitution of improved for old machinery, should be paid out of this depreciation account. There are, of course, many methods of bookkeeping in connection with depreciation accounts, but the above, in my opinion, gives the substantial result that should be aimed at.

THIRD SESSION.

WEDNESDAY EVENING, SEPTEMBER 23, 1896.

The meeting was called to order at 8 P. M., President LOWE in the chair. There was a large attendance of members and their friends, as well as many of the other guests of the hotel, both ladies and gentlemen.

The PRESIDENT. We have with us to-night by invitation of the Board of Government, a guest of the Association who will present before us an account of the enterprise of the city of Philadelphia in establishing an institution for the development of our commerce with the South American countries, particularly in the line of increasing that foreign market for goods manufactured in the United States. Although the Philadelphia Museums are organized and maintained by that city, they are not local in their purposes, but their resources are at the service of those who desire to avail themselves of the opportunities which this institution affords. It affords me great pleasure to present to you Dr. WILLIAM P. WILSON of Philadelphia, Director of the Philadelphia Museums, who will address the Association on "What the Philadelphia Museums can do for the New England Cotton Manufacturers." (Applause.)

WHAT THE PHILADELPHIA MUSEUMS CAN DO FOR THE NEW ENGLAND COTTON MANUFACTURERS.

WILLIAM P. WILSON, Sc. D., Philadelphia, Pa.

The institution which I am going to tell you about, and the ways in which I believe it can help you and other manufacturers, are entirely new to this country; not entirely so to the older European countries. In the first place a word or two of explanation about the name of the institution, which is entirely misleading. The Philadelphia Museums were organized in 1893-1894, after the Chicago Fair, the attempt being made through efforts of mine to secure for this object the exhibits of raw products in Chicago. Representation was made to the different ministers in Washington to the effect that if these countries would present their raw products, which existed in wonderful collections in Chicago, to Philadelphia, that city would take care of them and maintain them as a permanent exhibit of the raw products of Mexico and the Central and South American countries. It was argued that this might be made the means of greatly increasing our trade with these countries. In consequence of these efforts about twenty-four car loads of the finest and best materials in the exhibits in raw products in Chicago were taken to Philadelphia. Many things not belonging to the Commercial Museum were secured at the same time. The educational exhibits from thirteen different countries were taken from Chicago, including the German exhibit, the Russian exhibit, the entire Japanese exhibit — one-quarter of which was not exhibited at all in Chicago for want of room — the exhibits from Brazil, Argentine, Costa Rica, and other countries, making

the nucleus for a future pedagogical museum. The city conceived the idea of forming a group of museums, embracing the commercial, educational, ethnological and archæological departments, and making the institution after the plan of the South Kensington Museums. The city has already apportioned sixteen acres in one of its best localities and has begun to appropriate money to improve that ground. Within two months it has passed an ordinance appropriating $200,000 with which to begin a great museum building. We intend to ask the Legislature at its session next winter for a large sum of money to continue this building.

So much, then, for the name "Philadelphia Museums," which means a group of museums. It was conceived by those of us who were organizing this work that the commercial side of this group of museums should be developed, first, because the country was in great need of an institution of this nature. I should here say that twenty years ago Belgium founded a commercial museum in Brussels, and that much of the prosperity and great commerce of this small country is due to this enterprise. It was a government institution, and one of the first things it did was to begin to bring home for the study of its own manufacturers the manufactured products made in other countries for the world's trade. And Belgium very wisely put its national consular service under the direction of this museum. Similar to the Brussels Museum, but very much larger and more comprehensive, is the Imperial Institute in London. Great Britain is attempting to bring from all the colonies in one great stretch of buildings in London all their raw products for British inspection; the work is also supplemented by extensive exhibitions of foreign manufactured goods.

The Philadelphia Commercial Museum is divided into three departments: first, the department of raw products, in which we now have some 50,000 samples. I should say here that we are occupying the former offices of the Pennsylvania Railroad Company, which give us about 100 rooms admirably adapted to the needs of the museum. In this building we have arranged

our raw products in a series of about sixteen or eighteen rooms, classifying them in monographic exhibits. In one room you will find the woods of the world; that is, those that are most useful in commerce, so that if a man interested in piano cases, or hard woods for tool handles, or woods for machinery purposes, should come into this museum, in fifteen minutes he could be shown the special kinds of wood from twenty different countries such as would be suitable for his purposes. Again, in the fibre room — and it is the best collection of fibres I have seen in any museum — there are arranged in large cases the fibres classified: for instance, the manilla hemps in one great group. These are arranged with the crude plant, the leaves and other parts, also with photographs which may give you the complete history of the development of this fibre. We have also the fibre in mass, the intention being to have bales of these fibres so that one can carefully study them in great bulk. If you are interested in hemp, then many of the different hemps of the world are represented in another case. In still another are the flaxes. If you wish to study the fibres of Mexico, you find a case forty feet long displaying several hundred pounds of maguey, henequen and ixtle, all coming from the century plant. You will find the crude leaves of the plant, some of them partially macerated and some of them entire, enough to show you what these fibres come from. From all these exhibits you can study the most important fibres of the world and see whether or not you are using the best kinds for your purposes. Another room contains the dye stuffs, another the tobaccos, and another the raw silks. Here there are represented the developmental stages of the silk worm and everything that touches the silk worm. This alone would be a profitable exhibit educationally. Another room represents the animal products of the world; another contains the resins. And so it goes through sixteen or seventeen rooms that have been arranged in this way.

Now, we have rooms enough so that we have begun over again and represented these things geographically. In this arrangement Mexico comes first, because it is the nearest country

to us. Eight rooms are devoted entirely to Mexican products; one is given up to fibres. The interest in this industry is sufficient to give an annual export from Mexico of over $5,000,000, of which we take the greater part. Another room contains the gums, resins and tan-barks of Mexico; another the tobaccos, wines and sugars. Three rooms are devoted to 18,000 different specimens of Mexican woods. You may remember the wood collection which was in Chicago; it is preserved in its entirety in our Commercial Museum. We have a large collection which has just come up from Venezuela, occupying an immense room. The collection from the country of Costa Rica occupies four rooms. So we go on till we get into the Asiatic countries. We have rooms representing Japan, and Korea, and Johore, and several other of the larger and smaller Eastern countries. These articles are duplicated throughout. In the synoptic room they are brought together so that you can see all the specimens of a particular kind; while in the geographical room all the products of a single country are grouped together. In connection with this department of the museum we are contemplating a scientific and experimental bureau, where all the world's products will be brought together and intelligently tested with reference to discovery of any new application for them, in the uses of commerce.

We mean to make this a national institution and have it eventually supported, not solely by the city of Philadelphia, nor by the State of Pennsylvania, but on a larger scale than that: we mean to show its usefulness so that it will be voluntarily supported by the United States, and to make this a national institution. In the first place, we are connecting ourselves, with great care, with all the South American governments. We are showing them that we can act as a bureau for them; that we want their raw products and that it is to their interest to let us have them in complete detail. We have asked each of the Latin-American countries, including Mexico, to appoint commissions to gather and deliver to us their raw products, which are not half known in their own countries. We have asked them to appoint commissions, at their own expense, of intelli-

gent men, who shall be at our command for the writing and asking of information; and this is now going on in the different countries. We want the especial products. The business of these commissions will be somewhat as follows: in Brazil already the coffee industry is being carefully worked up and will be represented by four or five hundred sacks of coffee in our museum in the near future. Thus the special flavors of these different coffees may be studied and traced back to their respective farms. When we have done that for half a dozen different countries, we shall make a great coffee exhibit for all those in the United States who may be interested in coffee. We have already done that once in the wools. In our extensive wool room we have four tons of wool and hair from all over the world, the finest exhibition I have seen in any museum. The whole floor is devoted to wools and probably 2,000 fleeces from all different wool growing countries in the world are in this collection.

Our second department is that of manufactured goods. In this we are placing on exhibition goods which are brought into South America from France, Germany, England, Holland, Belgium and other countries, together with information concerning manufacture and sale; the name of the maker, the wholesale price, discount, amount imported, retail price, methods of packing, and every detail which an American manufacturer would need to know in order to enter into competition with the European manufacturer of foreign trade.

Our connections with the South American countries are intimate. We have been asking every chamber of commerce in those countries to enter into communication with us and appoint representatives to our advisory board. We have been in active communication for more than a year with the Chamber of Commerce in Caracas, Venezuela. That chamber has been vigorously working for us, as we expect every chamber in South America to work. We have received over 800 samples of goods from the Caracas Chamber of Commerce. This is what we are going to do in Brazil, Colombia, Argentine, Uruguay and the

other countries. We have over 20,000 samples of cotton goods alone. These have been brought together from every possible source, in order that American business men might study the markets for those countries. I have brought with me some accurate data to show what proportion of the trade of those countries we have, and what proportion Great Britain has. It would be an interesting thing, but I am not going to read it; statistics are dry. I am only going to say that we have a very small part of these markets. Take, for instance, Venezuela; the cotton goods that are imported there amount to $7,200,000 annually. Out of that we have $600,000, and France, Germany and Belgium have the rest. England has the lion's share; she has $3,600,000 of the cotton trade of Venezuela, and we have $600,000. Every condition in Venezuela is in favor of your having all of this trade. The freights from New York are 30 per cent. lower than those from European ports. We have regular steamship communication and even banking facilities. You can do your business direct, without any commission to London. And yet we have $600,000 of Venezuela's trade, and England has $3,600,000, and that is about the condition with all the other countries except Mexico. There we have a large share of the trade; we ought to take the rest of it.

The chambers of commerce are our first great means of connection for securing information for our bureau. The second are our special delegates which we are securing in all these countries. We have them in most of the countries already, and they are all prominent men and are working with great, impartial interest to stimulate trade between the United States and their own countries.

We have another means of connection through the United States consular service. Whenever we want information we send blanks to the consuls asking all the pertinent questions that can be asked about any given kind of goods or products. These blank inquiries are sent to the different consuls through the State Department.

A fourth source of our information is through private agents.

Wherever it seems advisable to have continuous studies made of any market, in more complete detail than could be done through our other correspondents, such agents are appointed. These are invariably sharp business men, and their reports are always carefully made and of much practical value.

Through all these sources, but especially through the chambers of commerce, we are receiving lists of thoroughly reliable business firms in their several countries. This will be extremely valuable to American business men. It is sometimes difficult for them to get into communication with reliable people in these countries; but we are gathering the names of such persons in all lines of trade. We give no ratings and we take no responsibility; but we do everything to make our reports equal to ratings. We are also obtaining concessions from various South American countries for the introduction of American manufactured goods for exhibition, no duty to be paid until the goods are sold. The idea is to establish bonded warehouses which shall be open to public inspection. Such concession has been granted to us in Venezuela and also in Argentine, and we have the promise of one from Uruguay. Such concessions will probably be granted in the near future in half a dozen other countries. We propose to turn these concessions over to large associations which will undertake to handle them. We cannot do it ourselves. The museum has nothing to do with actual buying or selling. The Venezuela concession has been placed in the hands of the National Association of Manufacturers, and the association proposes to hold an exhibition of American manufactures accordingly.

President LOWE. I would like to know who are entitled to the facilities which the museum offers?

Dr. WILSON. That would lead me to say that the city of Philadelphia has already spent in actual money between $200,000 and $300,000 for this work. They have given us sixteen acres of land and are now preparing it to give us a group of buildings. The museum itself, with its 50,000 raw products is open free to everyone. The exhibit of over 40,000 manufactured

products is also free to any one for any study whatsoever. We have already a reading room with 700 technical journals of trade, commerce and finance, coming from all parts of the world; sixty from London alone, of the best existing journals. The trade journals of Australia and New Zealand, journals from China and Japan, are among the number. The trade reports from Japan are coming to us regularly from the government. I had designed to give you fifteen minutes of dry statistics from the latest Japanese reports which I have thrown aside. These facilities are all open absolutely free to anybody.

We have established in connection with all this work a Bureau of Information. You can see that the connection of manufactured goods would be of comparatively small value unless we followed it up and told how much could be sold in each market, what the state of the trade is, and all about the shipping and every other matter connected with the market. That is all being worked out, but it takes men and time to do it, and men who are scientifically trained. By an elaborate system of indexing, we are in a position to give you at once every bit of information that is at hand in the museum. We can give you much more information than you could get from any source yourself, and we accompany it with exact samples of what is being sold in the various markets by your foreign competitors. That requires work in our bureau; it requires knowledge of where the things are; it requires a great deal of statistical work; and we propose to charge a small fee which will partially cover the expense of investigating and compiling and copying in the bureau. We propose to put the facilities of the bureau at the disposal of any manufacturer for an annual subscription of $50. The subscriber has monthly reports sent to him on his special business. Each report is intended to give him full information touching the entry of his goods into some foreign market; aiming not only to give him accurate knowledge concerning it, but to put him in communication with reliable people who might handle his goods. In addition to this the subscriber has the privilege of asking any special questions that he desires to have answered.

If we cannot answer them immediately, we send them out to the United States consul, or to our special agents, or to the chambers of commerce in foreign countries. When the replies are received we make full reports to the subscriber.

Just to give you an illustration: a large paper manufacturer comes to us and says, "My output is much more, or could be much more than I have an opening for. Is there any market for it in South America?" This was a question we could not answer. We had at that time a very sharp man in Argentina. He was immediately directed to make a thorough investigation of the paper trade there. We also sent out to the different consuls and agents and chambers of commerce, to have them find out what the different kinds of paper were which were being used for newspaper work, and their source also for book work and stationery, to secure statistics on the whole paper trade. In this way we were able to give a report which this gentleman could not have obtained for many thousands of dollars, even though a special agent had been sent for the purpose. We, as a public institution, are always able to get at the actual facts where a private person with a private purpose might not.

We have also agents in European countries. We do not stop our inquiries on the paper business by sending to the places where it is consumed, but we go to the other end. There we find out what paper is being exported and who is making it, and we get samples and full details; the amount sold, the styles, the wholesale and retail prices, and everything connected with the trade. In this way the gentleman who receives our report is in a position to sit right down and figure up whether he can compete in the markets he wishes to enter. This is our method of handling all subjects of inquiry.

It is our business also to go into every condition of tariff and freights. We are in communication with large numbers of shipping firms all over the country, who send us notice of every change in the freights and also notice of every vessel that goes to any river port which is difficult to reach. Through similar reports which come from our foreign connections we are able to

give the freight rates from European ports. In this way our subscribers can compare the rates and know in actual dollars and cents the advantage or disadvantage which they must meet. I should say here that you would probably be surprised to know in how many cases the advantage is with the American shipper.

We have only just begun to take subscribers in this way. The subscriptions which we have already received have come to us voluntarily, where gentlemen have come into the museum, looked the matter over and said, "I want to subscribe before I go away." We have had one or two gentlemen who have felt and expressed it to us, that the answer to their first inquiry was worth to them many times the amount of their subscription.

The Philadelphia Commercial Museum was founded upon the distinct understanding that it was to be a permanent exhibition for the benefit of all the people of the United States. In no sense is it a local institution. To emphasize the fact that it is a national institution, we have established an advisory board on which we have asked the chambers of commerce and boards of trade and manufacturers' associations throughout the country to become members. I am glad to say that your body was one of the first that responded to that invitation. Other bodies all over the United States have responded with equal cordiality. Among them are the Chamber of Commerce of Boston, a considerable number of similar bodies throughout New England, other organizations as far south as New Orleans and as far west as Tacoma. Every one is enthusiastic over the idea. We are doing what has never before been done by any country in this way. I think you can quickly see how it might help the United States in obtaining foreign trade. We wish these bodies all over the country to be in touch with us, for the reason that each one can represent special local interests, and give us advice as to what we might do in the broadest sense. That makes a very solid, national body, without any politics in it, and without any partiality. We are studying with the utmost care to make the institution national in its scope and to touch no question which would narrow it in any way whatever. There is not a single

advantage given to any manufacturer in Philadelphia that is not given in the same way to a manufacturer in Chicago, New Orleans, or San Francisco. I wish to give each individual member of this association a cordial invitation to visit and inspect the Philadelphia Museums, which will remain at 293 South Fourth Street until the new buildings are completed.

Mr. GEORGE S. BARNUM. Mr. President, in justice to Dr. WILSON I might say that I happened to be one of the delegates from the Chamber of Commerce of New Haven, Conn., who went down to see this museum, and I am confident that until one has been there he cannot begin to realize the importance of it and the interest attaching to it. I think if you would all take pains to go down there and look at it, you would see in fifteen minutes — with all due respect to the Doctor — more than he could tell you in a week's talk, and I certainly wish you would go and see it for yourselves. I am very much interested in it myself and I have succeeded in interesting a good many men in New Haven, and I think the Doctor will hear from them before long.

The PRESIDENT. I am glad to hear from Mr. BARNUM. I was just about to call upon him.

Dr. WILLIAM P. WILSON. I believe Mr. BARNUM, Mr. THOMPSON and Mr. KENT are the only three representatives of our Advisory Board who are present.

The PRESIDENT. I think so, Doctor.

Mr. GEORGE S. BARNUM. My colleague who went with me was equally as interested in it as I was. He went home with quite the same impression that I had.

Mr. FRANK P. BENNETT. I have listened with a great deal of interest and pleasure to Dr. WILSON'S explanation of that truly wonderful institution, the Philadelphia Museum. I did not suppose that it amounted to a tithe of what we now find it does amount to. We are not provincial; we are glad this is a nation. We are proud of Philadelphia, and we are proud of New Hampshire, and we are proud of every part of the United States. But sometimes I cannot help but wish that ten or fifteen years ago, when Mr. EDWARD ATKINSON asked this institution to go into the establishment of a textile museum in the city of Boston, that something might have been done in that direction at that time and continued up to the present.

Mr. J. PAYSON BRADLEY. The President has said that the

associate members are becoming an important element. I only see the importance in the fact that we are taxed double that which active members are taxed in the Association, and therefore I suppose we ought, as associate members, to have double the good things when we go on an excursion of this kind. To-night, Mr. President and fellow members, we have received double. It is doubly worth the entire assessment that has been placed for this fall meeting to come and listen to the remarks of Dr. WILSON here this evening on the Philadelphia Museums. It is something that I never dreamed of in all my life. I knew that something of that kind was going on, but I supposed if you went down to Philadelphia, the Doctor would show us what he has on the table before us, but this is, in the language of Holy Writ, only a half of what has been told. And I hope that the Association will take advantage of the invitation he has given and will call upon the doctor.

Mr. D. M. THOMPSON. I understand that the Board of Government desires an expression of the views of members present, relative to the location for the next fall meeting. I would suggest that the next meeting be held in Philadelphia, instead of Boston, or, if this is not advisable, that the fall meeting of 1897 be held in Philadelphia. It is a center of large manufacturing interests, favorably situated for the accommodation of Southern members, and ought to insure a large attendance. It will afford an early opportunity for examination of the Philadelphia Museums, and many other objects of deep interest to the members of the Association.

Dr. WILLIAM P. WILSON. I simply want to say that I should be very sorry to have any one of the members of this Association pass through Philadelphia and not come and visit the museum. I feel that it should be one of your first objective points when you come through Philadelphia, and we shall give you every opportunity to see everything there is in the exhibitions.

The PRESIDENT. We will now listen to the paper by Mr. EATON.

SUGGESTIONS FOR THE FUTURE WORK OF THE ASSOCIATION.

RUSSELL W. EATON, Brunswick, Maine.

I wish to say as I begin, that I present my views on the methods of work for the Association in the future, with little desire to press them too strongly upon the members. They are only intended as suggestions. I present this paper for consideration because having brought forward my ideas informally before the members of the Board of Government, the President asked me to lay them before you in a more formal way. I would be glad to have you think about the matter and discuss it here, or, if you prefer, delay the discussion of the subject to another meeting. If it does not meet your views at all, then drop it entirely.

This Association is composed largely of mill managers. The duties of a mill manager cover nearly every branch of mechanical engineering, and he is expected to know more or less of each one. From the putting in of the foundations of a new building to the delivery of the finished fabric, problems innumerable arise, and we must meet them all. None of us know all about all of these problems, but no one here who has had five years' experience in managing a mill but has learned something that would be valuable for the rest of us to know.

We all know more than any one of us, and each knows something of value to the others. Hence this Association. It is one, as I understand it, for the increase and propagation of knowledge in our line of business. When I come to a meeting I always wish that I knew as much about carding as this gentleman, or about

electricity as that one. I would like to be able to present to some member the problem that is perplexing me and get his advice. Another thing, subjects which can be investigated and decided definitely ought to be. But we rarely do this because no single member has the time.

Now, my proposal is that we divide the work of a cotton mill manager into departments, and divide the membership into committees, giving each committee one of these departments. I will attempt such a division: hydraulics, steam power, transmission of power by shafting and belting, electric lighting and power transmission, heating and moisture, construction of buildings including strength of materials, raw cotton including the transportation and the baling of same, methods in the picker room, carding room, warp spinning room, mule room, weaving room, cloth room, office methods, repair shop methods, relation of the mill to the employees, relation of the mill to the community, including, perhaps, taxation and valuation.

Here are about twenty topics; others may occur to you. Many of these topics are unrelated to the others. With a committee in charge of each of these divisions, we may expect that more thorough investigation will be made in each line. Once each year we can receive from each committee a report, if it has anything new to present or new thoughts on old topics. A committee might wish to have some outside man bring before us something in its line. Inventors, builders, or investigators would know from our committee lists to whom to apply at any time in order to present their ideas to us. The committees having, perhaps, the same members, or substantially the same, for two or three years we will say, will have ample time in which to pursue any investigations that appear important to them or that are referred to them by the Association at its meetings or by the Board of Government. I should not expect that presentation of papers would be done away with; on the contrary, it might lead to more of them at times.

In brief, my suggestion is, that we divide our labors and put a committee in charge of each branch. I should expect two

results: first, more thorough investigation and wider knowledge; second, since every member (who was willing) would belong to at least one committee, a greater personal interest in the real work of the Association.

The PRESIDENT. Do any members wish to discuss the question with Mr. EATON, or ask him any questions? The topical question following his paper is a very broad one: "Suggestions from each member on the future work of the Association. All members present are requested to be prepared to offer some suggestions." We thought that under this question might come the discussion as to where it was best to hold the meetings, and perhaps get an expression from the Association in that direction, as intimated in the remarks of the President at the last evening meeting, as well as upon many other points of importance. This question was suggested by Mr. GOODALE, and I take pleasure in calling upon him to open the discussion.

Mr. ALFRED M. GOODALE. Mr. President and gentlemen, the discussion of this question naturally comes under two heads: first, the work of the Board of Government, and secondly, the work of the members. I want particularly to speak of the work of the members of the Association, because it seems to me that it is not fair to the members of the Board of Government, after they have prepared a programme, not to have the members take more interest in helping the Board of Government carry out that programme by responding very much more heartily than they do to the request for papers, and for discussions on the topics. Now, if you will look back over the records of the meetings for the last eight or ten years, and lay on one side those papers

that have been presented by persons who are not members of the Association, you will find that the large majority of the papers, and the large majority of the discussions have been presented and been taken part in by the members of the Board of Government. They not only have to lay out — and I can speak very freely now, because I am off the Board — they not only have to lay out the programme, but they have to do a great deal of the work which they do not want to do themselves, simply because of the reluctance of members to take the time that is necessary to get up these papers and present them at these meetings. There are always certain members — and I think any member of the Board of Government for the last ten years will bear me out in this — there are always certain members who are willing to take hold whenever they are called upon, and in nearly every case those men are the men who have the largest mills and who are the busiest. I have never been able to find out the reason why the great majority of our three or four hundred members are not willing to take hold and to help the Board of Government in presenting interesting papers and interesting topics. I suppose one reason is that we all feel that there are certain things in connection with our own work that we do not want to talk very much about; but then, there is a very large field in manufacture, such as the use of steam, both live and exhaust, the experience of members with oils, the methods of making up costs — all those things affect us all equally, all alike, and anything that any one of us can give ought to be of use to all. Now, some two or three years ago, when the committee was appointed to collate the various methods of making up costs, that committee travelled some fifteen hundred miles and had three meetings in order to get the very best methods possible of making up costs, and when those various methods were presented at the meeting, there were not two pages of discussion by the members of the Association, and yet those papers had been sent to every member of this Association two weeks prior to that meeting.

Coming now to the work of the Board of Government, it

seems to me — I felt very strongly in regard to this recently — that there were certain broad lines—and Dr. WILSON has shown us to-night how much can be done in one special line — there were certain broad lines that the Board of Government can work upon, if they are only heartily seconded by the members. We are beginning now to get money in our treasury. We have — I have forgotten how much — but there is certainly a beginning, and there are certain things that are now being done by outsiders that could be very well done by the members of this Association. Take the investigation of oils. We have to take now very largely, most of us, what we are told in regard to oils; sometimes it is so, not always. At the same time there are a great many experiments that could have been made and have been made during different years of this Association, that have been of great value to the members. I think those experiments ought to be continued.

That is only one line. Now, I think there have been some twenty papers written since the Association was organized, in regard to the evil of receiving cotton as we do from the South. We have kicked against it in this Association ever since the Association was organized, and it has not amounted to the snapping of a finger. We get the cotton in exactly the same way, with exactly the same evils, that we did before. But I feel that if this Association, as large as it is to-day, could become associated for this purpose through committees with an association of treasurers — for instance, the Arkwright Club—it could accomplish much toward getting that evil remedied. It is being remedied slightly now by competition, but it will never be fully remedied so long as we take the cotton as we get it to-day without protest.

One point that I want to make above all others is that it is not the members of the Board of Government, it is not the Board of Government itself, that is the influence and makes the work of this Association, it is the members themselves. And unless they are willing to take their time and their evenings, as the members of the Board of Government have to, unless they

are willing to take their time and to give of their knowledge some particular point which they know better than any one else, unless they are willing to do that, the Board of Government cannot run the Association on the large lines on which it ought to be run. (Applause.)

The PRESIDENT. The Secretary would like to say a few words.

Mr. C. J. H. WOODBURY. Mr. President, not as Secretary, but as a member, I wish to add one thing relative to the statement of the last speaker, in his allusion to the report of the committee on making up costs. I believe that that report was appreciated as nothing else before the Association ever was appreciated, even if it was not so expressed in free discussion upon the floor. There has been such a demand for that issue of the Transactions that we have only half a dozen copies left, and the Secretary has received instructions that no more extra copies of that issue shall be sold until it can be determined whether the Association shall reprint that volume. (Applause.)

Mr. WILLIAM J. KENT. Mr. President, as one of the members of the Board of Government I cannot sit still here and listen to these remarks without putting in a word of mine, and saying to the members of this Association that we find as members of the Board of Government that there is a great deal of fault found in a narrow, backhanded way. A man comes up and stabs you in the back instead of coming right out and giving it to you straight in the face. Now these very men that find fault come and say, "Why don't you have your meeting there; why don't you have your meeting here; why don't you do this; why don't you do that?" I mean to put the question to them, "Why don't you do something; why don't you express yourselves to me or to some member of the Board of Government and tell us what you want to do?" I, for one, am an independent member of that Board of Government, and a good many

times I express my opinion, and sometimes I carry my point and sometimes I do not; I do not always expect to. But I look at it in this way, that a great many of the things that are to be decided, you put us there to decide. If you are not satisfied with our decision, you have the chance at the next annual meeting to put us out. So I hope in the future that you will express yourselves more fully and give us some idea, if you are not satisfied, what will satisfy you, and if you don't want to express yourselves, why, then, say nothing about it.

Mr. EDWARD W. THOMAS. The remarks of Mr. EATON upon this subject carry with them a great deal to be considered. I can say, from an experience of some years as one of the Board of Government, that much of the burden now imposed upon the board should be taken by the individual members, and I can conceive of no better method of so doing than that suggested by him. We have in our membership careful, painstaking men, who undoubtedly would be glad to share to some extent in making these meetings far more instructive and entertaining than we have heretofore realized.

For one, I would like to see carried out the suggestion of having committees appointed for special branches and subjects, to bring in reports of their work at each of our meetings. A careful selection of men fitted especially for subjects in which they are qualified ought to give the members of the Association a vast collection of information and data concerning our branch of the textile industry. For, to my mind, there is not in existence to-day an industry so little comprehended and so little thoroughly understood as that of the cotton industry. When the statement is made (and it is so made on the best of authority) that in the yarn we spin we loose 75 per cent. of the original strength of the fibres in our processes from bale to yarn, it seems as though there was a wide field for investigating and experimenting to adopt some means and improved processes to reduce this excessive loss of strength. We ought, if possible, to get the cotton planter, the factor, and all associated in the

line of handling cotton into our ranks, and learn all we possibly can.

There is much we might do as an association in the way of a more thorough study of the elements of the cotton fibre, and the best means of working it. Time passes on, and if we take the trouble to read up on the subject of what has been accomplished within the past fifty years, I do not think we need feel particularly proud of our position to-day. It is true we have had the benefits of improved forms of spindles for frames. We are now passing through an experience with improved looms, but in picking, carding, and mule spinning, we are plodding on the same old lines. The value of the waste products of a mill should be considered; on this particular point the Continent is far ahead of us. We have an immense field for the committees to work in, as suggested by Mr. EATON.

I would open our doors to anyone who is interested in the development of the cotton fibre. I also believe meetings of the Association should be held quarterly, and certainly two of them each year be held in manufacturing centres—Lowell, Fall River, New Bedford, Providence, Lawrence and Manchester, as well as many other of our larger manufacturing centres.

We should, it seems to me, take some active part in the establishment of technical and textile schools, and in this I doubt not we could ally ourselves with the woolen and worsted people. We are in a field of great future importance to the welfare of this country, but we must use new methods and bring the best out of our somewhat limited present education in manufacturing to a wider and broader field.

Mr. EATON in suggesting one, the last subject, viz., taxation and valuation of mill property, has brought up one of the least understood subjects in the list. Our standing as an Association and as an element of strength should be very materially advanced to a higher plane and to a stronger influence; and I most sincerely hope that the subject of appointment of committees may not be allowed to drop.

The PRESIDENT. The Board of Government is after ideas in this matter, and I want to call upon Mr. FRANK P. BENNETT. He is the editor of the *Wool and Cotton Reporter*, and is a new member, and of course is entirely unprejudiced, and can give us some original views.

Mr. FRANK P. BENNETT. Mr. President, I am not only unprejudiced but incompetent—

The PRESIDENT. I do not agree with you.

Mr. FRANK P. BENNETT. And I should have hardly had the temerity to accept the proposition to put in my name as a candidate for associate membership at all if I had not remembered a precept which was once given me by an intimate friend. He was the son of a very intemperate English weaver; he came over to this country when a small boy, and later in life he and I became very intimate friends. He pulled himself together when he was about nineteen years of age and he determined to make a man of himself. He was then a weaver in a mill; he became a loom fixer. When I knew him he was overseer in a small flannel mill, and from there he became overseer in a fancy cassimere mill in Providence, and then superintendent of a flannel mill, which he changed to a ladies' dress good mill and then to a fancy cassimere mill, and was exceedingly successful. We were intimate friends until the time of his death. He told me one day, in the course of a conversation, some things which he thought had helped him most in life. His mother could not read or write, but she was a woman of a good deal of character, and she said to him, "Charlie, always try to associate with those who know more and behave better than you do." And so when I was asked to put in my name as a candidate for associate membership, I remembered that precept and acted upon it and had the boldness to put my name in.

Mr. President, to-day we have visited the Flume, many of us, and as I beheld that wonderful work of nature, which was probably wrought out at a single movement of the hand of the Almighty, I could not help thinking that it was an excellent thing for us occasionally to leave the city and the machinery

which man has made and come back into the country which God has made, and see these wonderful works of mountain and forest and the Flume, and the other things which we have seen here to-day.

Last night there were explained to us some other workings of the great forces of the universe, in the paper which was read by Mr. GOODALE, prepared by Hon. ROBERT P. PORTER, and it was wonderful for us to realize how those people in Japan are saving money and developing themselves and making great progress upon a rate of wages upon which the people of the United States would starve. It seems to me that one of the great questions of the future for free trade England, even more than for the United States — free trade England, which boasts that she is the only nation in the world which throws down all barriers and says to all the earth, "Come in and beat us if you can" — what is going to be the attitude of England in the future toward this old world, this older civilization which can compete with her on such a basis as that?

We are living very fast in these days. I remember when I went to school, even, that all the territory west of the Mississippi River was considered the "Great American Desert," or the greater portion of it. Now we have coming to us out of the West, out of this new State of Nebraska which did not exist at that time, a gentleman who says, and apparently believes, that he is a child of destiny, and that the stars point to the fact so strongly that he is going to be the next president of the United States, that he not only does not need to follow the precepts of practical politics, but he does not even need to follow the precepts of commercial and individual honor. I say we are living very fast in these days, and one of the things which seems to have been disproven in this age of machinery, this age of great invention and development, is that the old adage about competition being the life of trade is a mistake. It is not always the life of trade. There are kinds of competition which are not the life of trade. There is a competition of bankrupt stocks; there is a competition of excessive supplies of merchandise. There

are many kinds of competition which, it has been proven, are not the life of trade. Competition of railroads is not considered to be the unqualified advantage that it used to be thought. The absence of competition in the production of petroleum has undoubtedly given to the world many inventions and a great decrease in the cost of production. I am not going to discuss at this time the question of trusts and combinations, but I do say, as bearing slightly upon the topic of the evening, that men are learning that instead of mutual strife between them in the same line of business, there should be mutual aid.

There are many of those matters upon which associations may unite, to the advantage of every individual member. Of course, there are men who say that associations of this kind do not amount to anything; that the members will not come in and give away things they know. Of course they will not come in and give away what belongs to their stockholders; but they will come in and assist each other, in line with the associations which are being established, the associations in every trade and in every profession.

I think, Mr. President, it was old Dr. JOHNSON, who wrote the dictionary, who divided all mankind into two classes, clubable and unclubable men; and it was not a very bad division, after all. By unclubable men he meant men who, from errors of the head or heart or stomach, do not like to associate together, but flock all alone by themselves. By clubable men he meant brighter, more active men, who get knowledge, who acquire wisdom, by touching elbows with each other, men like the members of the New England Cotton Manufacturers' Association, and men like the members of the numerous organizations and social clubs which are now becoming one of the great features of American life.

Mr. President, I believe that in spite of Japan's competition and in spite of the cherished opinions of the son of destiny from Nebraska, which opinions do not appear to be shared by any very large majority, I think, of the people of this country, the Anglo-Saxon spirit of conquest and determination will continue

to manifest itself in the textile industry of the United States and that it will go on conquering and to conquer for many generations to come. (Applause.)

The PRESIDENT. We want to hear from one of our associate members; they have become an important factor in our organization. I take pleasure in calling upon Mr. J. PAYSON BRADLEY for some ideas as to how the Association should be run.

Mr. J. PAYSON BRADLEY. Mr. President and gentlemen of the Association, I hardly know why the President, a few minutes ago, should inform me that I would have to speak on this subject. It was with fear and trembling that I promised him that I would say a word, and then, after I had promised, I wished I had never made the promise, because I suppose that the line of business which I have the honor to represent is somewhat disliked by the textile manufacturers of this country. But I took a good deal of courage, Mr. President, when Mr. GOODALE said here to-night, that it was one of the important branches in the textile industry as conducted at present. Of course at some future time some great inventor may construct machinery which will not need lubricating, but will run upon either the wits of the inventor or the bearing upon which he places it. But at present, gentlemen, I do not see but you are entirely in the hands of the oil men, and therefore I take pleasure in speaking a word this evening.

I also find that associate members can be expelled by a majority vote of the Association, and therefore, Mr. President, I obey your order. I have been interested in this Association for a great many years, but not as a member. For nearly twenty-five years I have been in touch with the cotton and woolen men not only of New England but all over the United States, and some of the best friends and some of the best men whom I have ever met have been cotton and woolen manufacturers; some have not. I can remember, in my younger days, when travelling for

that old and honorable concern, the Downer Oil Company, that I was told very plainly that I was considerable of a humbug, and that the door was on that side of the office and I could find the street easily; but I always found that by gentlemanly conduct on my part, and by working in a gentlemanly way, I finally accomplished my object. A gentleman on the platform [Mr. WOODBURY] perhaps will bear me out in what I am going to say. Mr. EDWARD ATKINSON about this time took up the problem, which we had solved, of how petroleum lubricating oil, which, as generally manufactured, was a dangerous article to have in a mill, could be made as safe as that which was manufactured by Mr. JOSHUA MERRILL of the Downer Oil Co., and the result is to-day you would find it almost impossible to run your high speed spindles on any other oil than petroleum.

It strikes me to-night that this Association, as it is organized, is doing a great work, and is branching out every year to make it larger. It is getting broader in its ideas. That narrowness which comes with a new industry has been swept away as we are getting older. You represent here the manufacturers. In that term I include the agents and the salaried men who are employed by the capital invested in the manufacture of textile fabrics. Most of those here, with a very few exceptions which I see before me, are salaried men, and no doubt are earning their salaries faithfully and are very anxious to produce at the lowest cost the very best goods that can be turned out from cotton. I think this Association can help itself by bringing in more of that which represents the capital of the mill. I am glad to see here to-night some who are treasurers, and those who are perhaps, direct owners of the mills. You can manufacture sometimes the most elegant goods in the world, but if you cannot sell those goods to advantage your mills will have to shut down. You can pile them up in your warehouses, but unless you can get their equivalent in good round dollars and not in the fifty-three cent dollar which has been spoken of here, you cannot run your mills; and it seems to me that the Association should reach out and interest more of those

who are direct owners of the mills. I am not quite sure in regard to your by-laws, but I believe those are eligible to active membership who are interested as agents, treasurers and owners of cotton mills. That might properly be extended to include your directors, thereby making the touch from the manufacturer and the seller to the mercantile part more compact, and in line with what has been said here to-night about reaching out from our own country to all the countries of the world.

Now, I believe in the gospel of brotherly love to all men, but I say, gentlemen, that I believe in America first and then the world next, when it comes right down to the business of getting your bread and butter. So I say, protection to yourselves here, and then after that, reaching out in competition with other nations all over the world; and we can accomplish this by making these meetings so interesting that the member will be compelled to come here. I would like, if I was an active member, to see the meetings made so interesting by papers and discussions and reaching out, as to-night, to the markets of the world, that the treasurers of every one of your mills should consider it a duty to be here and find out these points, and also, perchance, your boards of directors, that they might stir up the selling houses to a more active reaching out for a market for their goods.

Allusion has been made to Mr. EDWARD ATKINSON'S suggestion of some years ago, about establishing a textile museum in Boston. Within a few years from now will come the great Paris Exposition of 1900. It strikes me that this Association should begin to make some provision for coming in touch, as an association, with the Paris Exposition. No doubt to that exposition, as it has now been broadened out by the example of different expositions throughout the world, will come the whole world to show their products, and if Japan and China make the same progress the next four years as the last four, you will certainly meet in Paris in 1900 the products of the Chinese and Japanese loom, and you will want to be ready to meet it as an energetic working body. If you come in contact with the

treasurers and the capital interest in your mills, you will attract them so that they will be willing to appropriate money to back you in the fight against the competition which is coming from the other nations of the world. Thereby you build yourselves up into power, and this Association can be a power. There is no reason why you should wait ten or fifteen years to make the South bale the cotton the way they should. If we should send out fifty barrels of oil with wooden hoops and leaky heads, we should have it all back, with express charges to pay both ways and damages to the floor of the mill. You have it in your own hands. If you, as an Association, should refuse to receive cotton in the shabby way it is sent to you, you could soon put a stop to the present system. I have travelled through the South since the war, and I have seen cotton dumped into water full of clay before it was shipped, so that they have been selling you the soil of the South at the price charged for cotton, and the cotton has been baled so poorly that it is brought to your stations with a loss of four or five pounds to a bale. And you meekly sit down as individuals and let that thing go on. But as a body you have power so that you can launch out and have things almost your own way. Only work together and move forward as a unit, all working for one point, the interest of the cotton mills of America through the New England Cotton Manufacturers' Association. (Applause.)

Mr. D. M. THOMPSON. Mr. President, I would like to ask if the by-laws provide that the spring meeting shall be held in Boston?

The PRESIDENT. Not necessarily.

The SECRETARY. The spring meeting must be held in Boston once in five years. That is, by special act of the Massachusetts Legislature, Chapter 163, Acts of 1895, the Association is permitted to hold its annual meeting outside of the Commonwealth, except once in five years.

Mr. D. M. THOMPSON. I desire to refer for a moment to the matter suggested by a member of the Board of Government, who seems to feel that the members are finding a great deal of fault with the management of the Association. From such information as I have, I feel justified in the opinion that my friend is mistaken. There are marked evidences of confidence on the part of members who have been and are still satisfied to accept the judgment of the Board of Government upon all questions properly submitted for their consideration. Suggestions on the part of members or even differences of opinion, I believe, are far removed from any intention to find fault, or the feeling of dissatisfaction. We all know what responsibility means, and we appreciate the purpose and earnest effort on the part of the management to advance the interest of the Association upon broad and liberal lines. This spirit is apparent in the growth of membership and the steadily increasing interest which members have come to feel in the work of the Association.

This condition has resulted very largely from the changes in the general character of our meetings. In former years the meetings were held in Boston for a single day. The time was brief, members of long acquaintance would seldom meet, a handshake greeting or a nod of recognition had to suffice. The social functions necessary to a union of interest were not present. The introduction of the dinner between the sessions in Boston brought members closer together, and laid the foundation for the change in the location of meeting introduced two years since. We have all witnessed with much pleasure the effect of this change. Two or three days spent together has given opportunity for personal acquaintance of the members with each other, a strengthening of friendships, and the establishment of a common band of sympathy and interest,—a condition prerequisite and necessary to the permanent success of our organization.

It seems to me that there is a great deal of interest now manifest and such as to justify the hope of even better results in the future. In this connection I think the suggestion of Mr. EATON

is admirable. It is in the direction of special work, a division of labor upon lines of greatest utility. The work of the Association may be allotted to committees selected with reference to their peculiar fitness for special subjects. In order that the entire work may be properly under control of the general management, it would be advisable that the chairmen of the several committees should be members of the Board of Government, or in lieu thereof, the said Board should be represented by an appointment of one of its members upon each committee. Such an organization I have no doubt would minimize the labor to be performed and contribute most effectually toward the attainment of the ideal objects of the Association.

The PRESIDENT. I want to call upon one of our oldest and most constant members, Mr. S. S. SPENCER of Lancaster, Penn.

Mr. S. S. SPENCER. Mr. President, I don't know but I shall have to object to expressing an opinion for want of competence. I do not know that I can add anything to the suggestions of the paper which we are discussing now, except to emphasize your remarks last evening, that we should increase the membership and particularly try to increase the attendance.

With reference to what our ex-president [Mr. GOODALE] has said with regard to delinquents, I am one of the delinquents. Some members can say a great deal more than others. I happen to be one who cannot say very much; what I can do I shall be very happy to do. I think the suggestion of Mr. EATON'S as regards committees is a very good one. I believe that an important part of the work of the Association, a good part of it, the best of it, perhaps, is done in committees. If I can do any good there at any time, I shall be very glad to. I have no particular suggestions to make to-night, further than to increase the membership and try to increase the attendance. I do not suppose we get over a fourth of our members here. I wish there were three-fourths.

Mr. FRANK J. HALE. It goes without saying that the main work of this Association should be especially in the line of textile manufacture, and the detail of this work should be outlined by men who are directly connected with the mills.

The results obtained inside of the cotton mill still is the most important part, and really the life and the success of manufacturing, but as an auxiliary to this especial line of work of the Association, and in the line of educational work, I believe that the results of the meetings of the Association would be made more profitable if we would arrange to have our meetings in cities where we could make visits to manufacturing industries that perhaps are not connected in any way with textile work, but still are important elements in the make-up of our great industrial wealth of this country, and show the results and achievements that are being made by men of great power and ability.

Many members of our Association do not have the time, the opportunity, or, perhaps, the disposition to become interested in the great advancement that is being made in all lines of mechanical work outside of the special branch of textile manufacture in which they are now engaged. If care is taken in choosing our places of meeting, it seems to me that they can be so arranged as to be near at hand the places of interest to visit. These visits should be arranged previously by a committee appointed for the purpose, and the concerns that we are to visit should also be consulted and arrangements made to receive us, so that there would be no confusion, but have the trips a regular part of the program of the meetings.

We have had some experience of this kind in the past, and the results seem to me to have been profitable. Among the places visited were the Gorham Manufacturing Co. silver works, at Providence, and the Corliss Steam Engine Co. of the same city. While the meetings were in Boston, we visited the electric power plant of the West End Railroad, and also on a trip which was made down the harbor, we saw how the sewerage of the city of Boston was taken care of. While in the South the visit to the cotton compress was of value to us all.

If the next meeting is held at Philadelphia, there are many places that could be visited with profit; among those would be the extensive Baldwin Locomotive Works, the Cramp's Ship Yards, the sugar refineries, and many other places of interest that could be determined upon by the committee. In the future the places of meeting could be located so that arrangements could be made to increase our knowledge of various kinds of work, details of which many of us are now comparatively ignorant of. I would also suggest that visits could be made to the various machine shops that manufacture textile machinery. This department of mechanical work is more closely connected with cotton manufacturing than some of the other departments, and probably all machine builders would be glad to entertain members of the Association and the visits would be profitable and instructive.

Understand, it is not my idea to diminish in any degree the work of the Association along its legitimate line of textile manufacture, or shorten the meetings in any way, but simply to take up the times between the meetings ,which is now almost wasted, and to use it systematically in gaining more knowledge of other lines of industrial work.

The PRESIDENT. It is the large attendance which makes the meetings interesting, of course, and profitable. One thing is a fact, that all members, whether they attend or not, get the published *Transactions* and so, of course, are relying upon them, but we wish they would come to the meetings and help to make the transactions interesting and valuable.

The list of names that the President had selected to call upon for suggestions being completed, if there are members of the Association that have any suggestions, I wish they would present them at this time.

Mr. LOUIS SIMPSON. I would like to make a couple. I understand from what the Secretary stated that there is a paper in one of the previous proceedings which is greatly in demand. If that paper could be printed at the end of the volume of our present proceedings, I think that it would probably be an ad-

vantage to the members and would not cost the Association much. It would be cheaper than reprinting the whole volume of *Transactions*, the supply of which is running short.

The other matter was in reference to the suggestion of Mr. EATON, which I think very highly of. I would suggest that the directors should allot among themselves the chairmanship of those committees. I do not know how many directors you have. How many are there?

The SECRETARY. Six.

Mr. LOUIS SIMPSON. Six directors.

The SECRETARY. And two vice-presidents and a president.

Mr. LOUIS SIMPSON. Then you could have twelve committees. Each director would have the chairmanship of two of those committees, and I think by that means the directors would keep the full control of the Association, and yet make the members do more work, which it seems to me at present they are not inclined to do.

Mr. RUSSELL W. EATON. Mr. President, I brought out my proposition in regard to the committees, not as an original suggestion of mine — it is a method that is adopted by other associations. I should prefer myself that the matter should be left over until the next meeting, so that the members who are not here may have a chance to read the *Transactions* and get these ideas better in mind. By another meeting we may have thought out the problems a little better, and possibly by that time some modification of the schemes that have been proposed by the different members here, my own among the others, will be adopted, and one scheme made out of them. For the same reason that I should not care to have any positive action taken on my suggestion to-night because of the limited number, I should at the same time think it the best policy not to decide on our place of meeting, unless there were reasons that appeared to the President and other gentlemen who have thought the matter over carefully, why we should decide particularly on a place.

The PRESIDENT. I will say, in regard to the matter of autumn meetings, of course it is quite a departure for this association to go about from place to place. When the first break was made, and the first meeting was held outside of Boston, I think there were some members of the Association who never expected to see another meeting held. But it was very successful and it added to the membership very materially. When the Association decided to go to Atlanta, I know there were some who looked upon it as a very wrong thing to do. It proved to be one of the greatest successes, so far as holding meetings was concerned, that the Association ever made. It is difficult, of course, for the Board of Government to decide upon a place of meeting in the autumn that is satisfactory to everyone. I have had many suggestions in regard to the place of holding this meeting; so many, in fact, that it occurred to me that it might be well to present the matter to the members who should attend this autumn meeting, and for that reason I made the suggestion which I did last evening. Of course it is for the members to act upon.

Mr. JOSEPH H. KENDRICK. Mr. President, before the meeting adjourns I would like to call the attention of the members to the new method of baling cotton, a sample of which is in the corridor, near the door, and in regard to which something will be said to-morrow morning before the Association.

The PRESIDENT. Before the meeting shall adjourn, I would like to ask the members to be as prompt as possible in coming into the meeting in the morning at 9.30. There are several papers, and some of the members are anxious to get away, I understand, on the 12.50 train. We have one other paper on our programme for this evening. If it is the pleasure of the Association the members present will listen to a paper on "A Few Suggestions to Superintendents," by Mr. JOHN S. ADAMS, Jr., of Adams, Mass.

A FEW SUGGESTIONS TO SUPERINTENDENTS.

JOHN S. ADAMS, JR., ADAMS, MASS.

It is not my intention at this time to go into all the details of the manufacture of yarns, or to carry on a lengthy discussion of any one subject, but to point out a few of the places which are sometimes overlooked even in mills which bear A 1 reputations. Nor is this paper intended so much for those who are old veterans in a mill, but for the younger superintendents who have yet to make their mark.

The more automatic a machine, the more the tendency to depend on that machine to do the work heretofore done by the brain. This is all right, but in no case should it lead to neglect. Machines made to-day require as much care and attention as those made a quarter of a century ago. The nearer a machine is to perfection, the greater the demand on that machine for not only quantity, but quality.

Quantity, quality, and cost are, or should be, the three watchwords of every manager or superintendent, and how to increase the two former and decrease the latter is not a study of a day or a year, but an everlasting keeping at it so long as you are in the harness. The faculty of keeping track of details and taking advantage of failures counts for much in a business life.

If I am rightly informed, it is the custom of a great many mills to run the sliver through a railway head before going to the combers, but not afterwards. If the combers always delivered a sliver of uniform weight I would have nothing to say regarding this point, but they do not, and if a railway head is a good thing to regulate the weight of the sliver before going to

the combers, why is it not a better thing to regulate the sliver afterwards? Although many will differ with me in regard to the value of a railway, yet I believe it to be a very necessary machine, and although many doublings tend to produce an even thread, the railway gives you a more even sliver to begin with.

The drawing frame is a comparatively simple machine, but I have seen much uneven work made on a drawing frame. I do not refer so much to bad rolls as to improperly working stop motions and bad piecings. As a rule, if a boss carder has help to work in and they are not skilful enough to work on the cards or speeders, he puts them on the drawing. It is, perhaps, a hard but comparatively simple matter to run drawing, but as all the stock goes through these machines, it is of vital importance that the work should be well done. An improperly working stop motion lets an end run through; a careless operator pieces up the end but does not take out the single and you get a variation of sometimes several numbers of yarn, according to the number of doublings and draughts beyond. Perhaps you think they don't do it in your mill, but get where you can watch the drawing tenders unobserved and you may see some one making either singles or doubles. Help watch a superintendent pretty sharply and when he is around they are full of business. I have seen more or less of it done in our mill and have seen it done in other mills, and have seen spinning rooms run very badly in consequence of bad splices on drawing and speeders. There is no mill but what gets some bad work, but some mills get more than others. There will always be careless help, and perhaps careless overseers in every mill, and it might not be a bad idea for every superintendent to spend part of his time looking after them. It is not human nature for any overseer to point out his own weak points to the superintendent, so it is quite necessary that the superintendent should be able to judge correctly of the different processes through which his cotton goes. Overseers sometimes, however, labor under disadvantages which should be taken into consideration, and all possible aid should be rendered them to improved the running of their rooms.

Give them good tools and proper stock and demand good work. Encourage them all you can; keep them awake to the advancement of the times and interested in their work and you will generally get the best there is in them; but keep them feeling like whipped curs and they do their work simply from necessity, and no more of it than they are obliged to.

Many of our mills are adopting the large ring and long traverse, and it may not be out of place to say a few words in regard to it. In changing to a large ring and long traverse each one must determine for himself just how far he can go and where to stop. The conditions are so different in different mills that it would be impossible to lay down any fixed law in regard to it. You will all have plenty of opportunity to exercise your skill as spinners before you get everything adjusted right, and it would not be a bad idea to "make haste slowly." I am confident, however, that you will be well satisfied with the results you obtain.

There must be, to begin with, well prepared roving, and every part of the frame as perfect as possible. The bobbin, of proper diameter, must run perfectly steady and the rings be perfectly concentric with the spindle at all points of its traverse, and well burnished. It would not be a bad idea to run the ring on a coarser number of yarn than you intend to run ultimately, till the ring gets seasoned, so to speak, and with a good overseer to push it you are ready to save money. You will require no more spinners and can dispense with some of your doff boys, as there will be less doffing, consequently less cost and an increase in production, as the belt is on the tight pulley longer; less knots to tie in spooling, hence better work, and a large saving in that department. I think I am perfectly safe in saying that any superintendent can guarantee to his treasurer at least 15 per cent. on the cost of changing from small to large rings.

We have in our mill an Excelsior spinning frame built by the Fall River Machine Co., and a description of it and the work produced by it may be of some interest. The frame has 168 spindles, 2½ inch ring, 3¼-inch space, 7½-inch traverse, double draught, condenser trumpets between front and middle

roll, and an attachment for breaking back the roving whenever an end breaks,—invented by Messrs. H. D. MARTIN and JAMES P. TOLMAN of the Sampson Cordage Co., of Shirley, Mass. The frame was designed to spin from No. 4 to No. 12 yarn. We had been obliged previous to adopting large rings, to spin our coarse yarn on a 1⅝-inch and 1¾-inch ring, which not only made it expensive, but made many knots which never failed to show themselves; and as at least one-half the breakage of the warp in a loom is caused by knots, it was a very serious matter. On the old style frame we got about 425 yards of No. 6 yarn on a bobbin and a production of 6½ lbs. per spindle per week. We now get over 1500 yards on a bobbin and a production of about 9½ lbs. per spindle per week (⅞ inch front roll, running 196 revolutions per minute), the yarn being of as good quality as that made on the small ring. On No. 12 yarn, however, I have not obtained as good results at proportionate speed with the excelsior frame; and as my tests are not complete at this time I will not say that the frame cannot produce equally as good yarn as the single draught frame. In order to show the results obtained by me in spinning No. 12 yarn I have given at the end of this article a test of 120 bobbins of yarn. In conducting this test I put in my speeders 80 bobbins of .75 hank roving, and made 40 bobbins of 1.80 hank roving. I then put the slubber roving in the Excelsior frame, putting the two bobbins that were together in the slubber together in the frame, and spun 40 bobbins of yarn with the condenser trumpets on the frame. I then took off the condenser trumpets and spun 40 bobbins more. The draught of the frame was 5.8 inches between the front and middle roll and 5.6 inches between the middle and back roll, making a total of 32.48 inches. The 40 bobbins of 1.80 hank roving I put in our common frame, using a draught of 6.67 inches, the speed of the front roll and the twist being practically alike in all three tests. The cotton used was 1⅛ inch staple, 25 per cent. card waste mixed in. I expect to make further tests and hope to obtain better results with the Excelsior

frame, as the tests made so far with our standard yarn are much more satisfactory.

The condenser, which is placed between the front and middle rolls, is a valuable feature for this frame, as it concentrates and guides the loose fibres to the bite of the front roll, the breakage of ends being greatly increased without it. In using the roving breaker, we take off all under-clearers, and the thread guides, being replaced by part of the roving breaker, are also dispensed with. The amount of lap waste on a frame is reduced to a minimum, as all that can possibly be made when an end breaks is from what cotton is between the front and back roll, and that which is made being in better condition to work over than the lap waste wound around an under-clearer. They undoubtedly save a great deal of bad work, and yet are responsible for some, as I find that the spinners do not make as good splices without under-clearers as with them. I have run the Excelsior frame with and without the roving breaker and find that it is indispensable. It not only saves waste but prevents the front steel roll from winding up with lap waste, thereby forcing the brass condenser guides against the middle steel roll, which not only cuts them off but injures the steel roll. The general quality of the yarn is also greatly improved by using this device.

Competition among mills is growing stronger each day, which calls for increased skill, and it is only by adopting the best methods and by tireless energy on the part of every man of responsibility that any mill can hope to make for itself a record and keep it.

TEST OF 120 BOBBINS OF YARN IN HALF SKEINS, OR 60 YARDS.

Ex. Frame. With trumpets.		Ex. Frame. No trumpets.		Common Frame. 1¾ inch Ring.	
Grs.	Br. Wt.	Grs.	Br. Wt.	Grs.	Br. Wt.
44	77	43.2	76	43.2	91
42.7	80	42.2	75	43.5	88
43.5	79	43.7	77	42.2	85
41.7	75	43.5	78	43.7	92
42.7	77	41.8	77	43.	90
43.5	77	42.7	76	42.	89
43.2	81	42.	74	43.2	89
44.2	79	44.5	80	42.7	86
43.5	79	43.2	82	42.	87
41.8	75	42.	74	42.7	89
430.8	779	428.8	769	428.2	886 Totals.
86.2	156	85.8	154	85.6	177
		Average for 120 yards.			
11.60		11.66		11.68	
		Average number of yarn.			

Each test represents an average of four (4) bobbins of yarn.

The PRESIDENT. You have heard the paper by Mr. ADAMS, and as President of the Association I want to thank him, as one of the newer members, for the paper that he has presented. Are there any questions or any discussions upon this paper?

Mr. GEORGE F. MORGAN. Mr. President, I would like to ask the gentleman how fast he runs his spindles?

Mr. JOHN S. ADAMS, JR. I think the spindle is running on No. 6 yarn, 6,300 revolutions per minute.

Mr. GEORGE F. MORGAN. When the bobbin is nearly filled,

is there any trembling of the spindle by reason of the excessive weight of yarn added to it?

Mr. JOHN S. ADAMS, JR. They seem to run fully as steady when the spindle is full as when it is empty. When we first started up the spindles I will say that we had some trouble with them; when we put them in they would tremble after they had run a little. The spindle was the Draper No. 4. We went over the spindles and re-adjusted them, and since that time they have run very steady.

Mr. GEORGE F. MORGAN. One more question, Mr. President. I would like to ask the gentleman if he did not find it made an extra amount of work on the part of the spinner to be obliged to piece up her roving before she could piece her end?

Mr. JOHN S. ADAMS, JR. We found first some difficulty with the spinners when they first started, as the roving breaker was something that they were not used to, and they had to get accustomed to it; but I have overcome that difficulty and they have found that they could run the frame all right, so that they have no more trouble now.

Mr. STEPHEN A. KNIGHT. Mr. President, owing to the lateness of the hour I would suggest that any further discussions of this or any other subject should be postponed and the meeting adjourned.

The motion was seconded and carried and the meeting thereupon, at 11.15 P. M., adjourned to Thursday morning at 9.30.

FOURTH SESSION.

PROFILE HOUSE, SEPTEMBER 24, 1896.

The meeting was called to order at 9.30 A. M., President LOWE in the chair.

The PRESIDENT. The first matter we shall take up this morning is a paper upon "Loom and Loom-fixers, Weavers and Weaving Rooms," by Mr. ALFRED HAWKESWORTH of Montreal. We will take it up before the topical question "What is the best way to pay section hands?" because it is in connection with that, and if there are any gentlemen who wish to discuss that, it can come after the paper has been read.

LOOMS AND LOOM FIXERS; WEAVERS AND WEAVING ROOMS.

ALFRED HAWKESWORTH, MONTREAL, P. Q.

The subject above mentioned is one of such magnitude that it would be impossible to do it justice in any one paper that could be read at this meeting. Volumes have and more will be written upon looms alone. We have looms of all descriptions for all kinds of fabrics, textile and otherwise. And the "art of weaving" is almost as old as the human race itself. The ancient world excelled in beautiful, expensive, and intricate fabrics that must have required both the skill of the weaver and his loom. He may have been his own loom fixer and his weaving room the open air, but he certainly accomplished results that we have either not had time to imitate or the skill to improve.

The power loom is of modern invention and has entered largely into giving to the world a variety of fabrics that otherwise would by their expense have been confined to the few. Weavers are now easily taught their trade and they are as numerous as the requirements for clothing the million. Textile fabrics are manfactured in such quantities that the slower methods of the hand have given way to the rush of producing thousands of yards of goods, while the weaver of ancient days was preparing to seat himself before his loom so that the sun in its flight would not cast its rays with too much force upon either himself or his loom, that was placed under the shadow of some tree for convenience and comfort.

LOOMS.

Looms are machines for interlacing threads of any kind of material. Looms that use a shuttle may be divided into three classes, and to one of these classes, or a combination of them, belong all looms, however special their use may be.

First comes the plain or picker stick loom, that uses a fly shuttle.

Second, the positive motion loom, where the shuttle is drawn through the yarn by its carrier.

Third, the rack and pinion loom, where a number of shuttles are drawn by the alternating motion of the rack from side to side of the openings in the warp.

The history of the development and improvement of the loom is but a repetition of the history of all machines used in the manufacture of textile fabrics.

Before the invention of the "fly shuttle" by KAY in 1743, undoubtedly there were many forms of the lay, temple, let off and take up motion. I might trace for you the gradual development of the various parts of the loom and even give you some ancient history connected with some wonderful achievement conceived in the brain of a weaver whose duty it was to make the fabrics worn by Egypt's great queen, but I should only be giving you a history of the patent office.

The plain or picker stick loom is the most important of the three classes of looms and it is used for more varied purposes than any of the others. We as cotton manufacturers have more knowledge of this style of loom than any other, and therefore, I will not attempt to make this a paper treating of looms in general, but I will endeavor to state some things that I have learned in my experience, as necessary and useful, in the make-up of a good plain loom.

There are a great many makers of plain looms and each one claims for his own some particular good points in their construction, either for cheapness in running or high production. A good loom is an important machine in a cotton mill and upon

it depends in a certain measure the success of such a mill. It seems to me that the attention of our machine builders was for a number of years turned away from looms and entirely given to the improvement of other parts of cotton machinery. The weaving department of the cotton mill is the place of great cost and too much attention cannot be given to it, nor can we get anything in the shape of a loom that is too good for our use. Invention has been quite slow, or rather very little of it has been used until quite recently, to improve the plain cotton loom. The Northrop loom marks the beginning of the wonderful possibilities that may, and will be, attained in weaving certain classes of textile fabrics automatically. It is a much needed invention and reflects great credit upon its promoters. The loom above mentioned promises to meet the requirements of some classes of plain weaving, but some of us, for a number of years at least, will be compelled to use old, if not to purchase new looms, of some other make and it would be well for us to consider and study the very best that we can get from the best maker, or rather to incorporate into one machine the good points of all, so far as they can be made practical to our requirements.

To the construction of looms we have not until quite recently given that attention that their importance in the production of high class cloths require. The plain loom should form and does the basis of all loom construction. This should be given every attention in detail and all its parts made with a correct knowledge of what their duty is in the make-up of a first-class loom.

I will not now give you any figures as to how much it costs to operate the various looms that our mills are filled with nor say how great a percentage of product each kind can be made to show, but will endeavor to point out some of the requirements of a good loom, that has for its object the weaving of cotton goods of high counts and perfect quality.

The most important part of a loom and that more than any other one particular part assists in producing perfect goods is the batten or lay, the shuttle race of the batten, its pivots and

shuttle boxes, shuttle binders, and shuttle. A stiff, heavy lay is absolutely needed to weave stout, heavy sheetings and shirtings such as are made by the Horrocksess of Manchester and Preston, England, the Grosvenordale Company, the 100s and "Fruits" of the firm of B. B. & R. Knight, Providence, R. I., and the York Mills.

The heavy lay will be no disadvantage in weaving lighter fabrics, any more than slight increase in power, but a mill expecting to change from one class of goods to another, such as our trade is constantly demanding, will do well to remember this in ordering new looms. We have erred in the past in this direction and some of us are now using a great many looms that are too light, both in lay and frames, for some classes of goods that we are trying to weave upon them. The lay should be pivotted in the centre of its swing, not only to assist in beating up the pick but to so place the weft that we shall see a straight line both before as well as after the finishing. This particular point I have found to be just as important in giving cover or face to cloth as to the shape of the harness cam, the starting of the same, and the adjustment of the harness straps. I might say here, in passing, that the Whitin loom is pivotted at the front of its swing and places its pick of weft into position with the leg of the lay upright, thus throwing the strain of beating up the weft upon the tooth of the driving gear and causing a good deal of backlash and what is termed in weaving as "bumping" when the goods are heavy. This particular way of pivotting the lay puts the greater strain upon the lower half of the warp when weft is being beaten into place, and making the upper half proportionately loose, and gives cover, but very often rowiness to the cloth by forcing one pick of weft to ride partly upon the other and so throwing it out of line. However, do not think I am trying to find fault with the Whitin loom, for as a whole I think very well of them, but on this point and a few others, they can be improved.

Allow me to digress here and say that cover on cloth is not, as some suppose, the crowding of the different picks of weft one

partly over the other. Cover on cloth is the filling up of the interstices between warp and weft and the prevention of twoiness or distinct lines in either direction, and is best attained when proper judgment is used in selecting sley and pick, together with the different sizes of warp and weft, suitable harness cams and setting of the same, with the straps arranged so that the strain upon the yarn is kept equal and easy at the beating up of the picks.

A movable pivot in a loom would be a convenience, and on some classes of goods assist the weaver very much in getting the counts required, but the proper place to hang the lay is in the centre of its swing. English loom builders invariably arrange their machines so that the picks are beaten up to place as the lay falls from the top centre of the crank-shaft towards the fell of the cloth. This gives an advantage when weaving heavy goods, by adding the weight of the lay to assist the belt when the strain is hardest. Our American loom builders arrange their machines to beat up the picks as the lay rises from the bottom centre of the crank-shaft toward the fell of the cloth, thus throwing the strain back upon the belt and the tooth of the driving gear to carry the rising lay. To this method of driving we must ascribe a great part of the wear we find upon the straight tooth driving gears. Modern looms are now using a saw toothed gear that does not entirely remedy this evil nor will it until we see fit to change this method of running our looms. The swing or sweep of a 40-inch loom should be 4½ inches, and upon standard sheetings, ranging from 2¾ to 3½ yards to the pound, this width of a loom can be run practically at 175 picks, giving for full pick and perfect goods with average yarns 87½ to 90 per cent. of running time in length of cloth. Always look with suspicion upon a loom giving 95 or more per cent. Upon low sleyed goods in 30-inch looms, 200 to 220 picks per minute are now being run successfully. Upon this width of loom a 4-inch sweep is all that is necessary and is indeed preferable on account of the speed required.

The race or track of the shuttle in its passage from one box

to another should have a good deal of attention given to it, for upon its smoothness and if you will, trueness, the shuttle has to depend. The lay should be made from good, dry white ash, properly seasoned, so that it will keep its shape. The race or that part of the lay in front of the reed for a 1¾ inch shuttle, should be at least 3½ inches wide. It should never be iron shod, but covered with fine smooth cherry or mahogany, to prevent the wear of shuttle shoes, and also the friction, which delays and diverts the shuttle, causing many breakages in yarn, looms and shuttle.

The race on a 40-inch loom should be depressed at least three-eighths of an inch in the centre; this will cause the shuttle to travel with more accuracy in its elliptic flight across the yarn from one box to another, assisted by centre depression of the race that actually makes of it an ellipse, and to protect the upper shed of the warp from the breakage caused by the tendency that shuttles have to rise when travelling across a level race.

A straight race, lined from one box to another, is quite necessary and particular attention should be given this by the loom-fixer, so that the shuttle will ride true in its flight across the yarn from one box to its opposite. The striking of shuttles against the front of shuttle box is an evil and the cause of much expense for both shuttles, reeds and other parts that come directly near to the boxes on each side of the loom. Upon 5-4 and 6-4 and wider looms I have frequently been obliged to turn the eye of the shuttle toward the reed to prevent the strain of the unwinding weft from dragging the shuttle out of line and causing it to strike the mouth of its opposite box. I refer now to looms having a narrow level race, such as are found on all widths of the Whitin loom.

In this direction a wider depressed race will be found to cure the evil, together with a proper care in adjusting the binders upon the front of the shuttle box. The eye of the shuttle should always be toward the weaver and facing the fell of the cloth, otherwise the shuttle would have to pass over it and frequently

cut or else mark the weft. The shuttle binders should always be placed so they will crowd the shuttle toward the reed, and the shoes of the shuttle should be slightly beveled, to assist the binders in keeping the shuttle true with its opposite box.

Great care should be taken in selecting shuttles to get the best wood and the correct length and width for the work we expect from them. This subject has not been given the attention it might, and we wear out our shuttles and break up our looms in trying to make them run when they do not want anything but the right kind of a shuttle to make them work smooth and nice. The length of the shuttle is very important and should be carefully considered when ordering looms, so that the boxes will be made of proper length and width to accommodate them. It is a mistake to think that we can run a 40-inch loom with as short a shuttle as a 30-inch loom; we cannot and get the best results. For a 40-inch loom we require a 14-inch shuttle, 1½ to 1¾ inches wide, about 1½ inches deep, to weigh about 8½ ounces. For a 30-inch loom, 12¾ to 13 inches will be found to be correct, 1½ inches wide and of about the same depth, to weigh 7 ounces. For the wider sheeting looms, 17 to 17½ inches long, 1¾ to 2 inches wide and of the same depth, weight about 16 ounces.

Very heavy or very light woods should be avoided in selecting material for shuttles. One of the very best woods of which shuttles for cotton weaving are made is termed "southern dogwood." This is not what some call "persimmon," but is nearly allied to apple tree in its grain and weight.

A good shuttle should be balanced on its centres and of equal weight on each end, and where they run in pairs, of equal weight as well. Patent bobbin-holders and bobbin springs and stops of different makes that cause the heel of the shuttle to become much heavier than the nose or weft end, should be counterbalanced on its opposite end, if we expect that it will ride across the yarn at great speed with any degree of accuracy or precision.

The shuttle throwing motion as well as the picker stick should command attention. One of the best devices for throwing the shuttle on an under pick loom is known as the "Stearns" par-

allel motion, and if our loom builders would arrange the shuttle boxes so that the picker could be run loose upon the stick, we should then have a nearly parallel throw. To run the picker loose upon the stick, the shuttle boxes should be covered to prevent the rising of the shuttle, and the picking cams arranged so that the stick will not require buffing in the front. The picking cam that gives the power to throw the shuttle should be arranged so that it can be adjusted as in the new Mason loom, by lowering the ball upon the cam.

Still more attention should be given to quick delivery than to a dragging pick. A slow, tight pick is a source of much false fixing in a weaving room, and our loom-fixers fail to understand that to cause tightness of draw upon the ball and cam will break picking sticks and rather retard than assist the throwing of the shuttle. Where the cam labors hard or straps are too tight, the "Stearns" motion will jump and raise at the heel, causing the shuttle to be delivered untrue.

The old style "bat-wing" cam has been discarded on account of its long, dragging action. We require a short, quick blow and an immediate release after the work is done. The higher the speed of the loom, more attention should be given here. A chilled ball and cam, mathematically constructed to answer above requirements, should be furnished with every loom.

These parts should not be allowed to wear much; if they do and are not replaced, however skilful the loom-fixer may be in "making the loom run," he will cause the shuttle to rise in the opposite box, put great strain upon his picking stick, heel strap, and spring, and oftentimes break and wear the yarn by the improper throwing of the shuttle. There are a great many devices of ball and cam for shuttle throwing; some of them possess merit, while others are a "sore vexation." The cone shaped ball and concave cam to match, are much used upon Whitin, Colvin, and Mason looms, but I am of the opinion that a simpler device of the raised tip and straight faced truck are quicker in their action and smoother of release.

The picker stick should never be buffed when drawn forward

to deliver the shuttle, but should be like the bow-string, drawn to a quick release, assisted to its backward position by an elastic spring that will hold it just past the centre of the shuttle box so that it can act to prevent recoil when receiving the shuttle from the opposite side.

The swing connecting ball or cam with picker stick should be carefully measured, so that the forward movement of the stick will be as short as will be consistent with quick release and yet long enough to prevent loomfixers from drawing the straps too tight. This is a place of great importance to the proper throwing of the shuttle, and pardon me if I say here that half the ills that weaving is heir to, comes from breakages, due in a great measure to the imperfect throw of the shuttles. The cams for moving the different sheds or leaves of the harnesses have been given a great deal of attention by our loom builders, but not more than the subject deserves.

Upon low sleyed goods almost any shape of a cam can be made to answer, but when the best results are desired, a cam has been sought after that will give an easy motion to the harnesses and yet open the sheds rapidly enough so that the shuttle can pass through the yarn without striking the selvedges and still to have dwell enough to allow the shuttle to escape into the opposite box before the sheds close upon it.

Weavers have found that particular goods require, for the best results, cams of suitable shape. Thus for light goods that require evenness more than strain upon the beat, the nearer we can get to a round cam the easier will be the movements of the harnesses and evener cloth will result, independent of either let-off or take-up.

The nose or striking part of the cam, as well as the heel or release, must have the proper amount of dwell considered, so that although the shed must be opened more rapidly than it closes, the first half of the revolution of the crank shaft should find the cam not more than half round its circle, while the last half of the revolution of the crank shaft should be completed before the shed is closed. This allows the yarn after being taut

to come easy to the point of crossing and lays the picks of weft side by side without the jar or jump caused by a flat or sharp nosed cam and will give an even, smooth piece of cloth. One of the very best cams for weaving light goods that I have come across in my experience, is made by the Colvin Loom Works of River Point, R. I., and will, if properly strapped to the harness jacks, be found in practice very efficient in this direction, without the assistance of thick or thin place preventers.

For higher sleyed goods, whether looms run high or low speed, we require the nose or striking point of the harness cam to be sharper or more decisive in its action with a corresponding dwell when sheds are open. Cams of this description are found upon the Mason, Colvin, Lowell and Whitin looms. My preference is toward the one found on the Whitin loom. This form of cam gives more cover to the cloth than the rounder form, by allowing the yarn to come to the point of crossing looser and thus prevents twoiness and also assists the lay in beating the picks up to place.

For still higher sleyed and heavier goods we require a sharper cam with corresponding dwell. The quick motion opens the sheds on heavy bodies of warp so that the resistance is overcome quickly and the shuttle does not strike the yarn. In weaving heavy goods on the rounder form of cam, the shuttle often strikes the upper shed of the warp, causing what is termed in weaving as "slattered threads," and we do not always stop to think just where the trouble lies, but tighten up our warps, thus making it still harder for the harness cams to open the sheds. As I remember back into the history of weaving heavy goods, the first cams suitable for this purpose were made by the Whitin loom builders, and I know for a number of years it caused looms built by this firm to be accounted the best in the country. A cam quite suitable for heavy weaving will give cover to cloth, hence the reputation in this direction acquired by the Whitin loom. Weavers have found by experience that for general weaving on medium weight goods a rounder form of cam will

answer much better than those more abrupt in their action upon the harnesses.

Plain looms should be supplied with two sets of harness cams, those intended for light and medium goods with an almost round and medium cam, while those intended for heavy and medium goods with a medium and flat or sharp cam.

The particular point of opening the sheds or of starting the harness cams with relation to the position of the lay has caused many a weaver a good deal of thought and is by some given more prominence than it deserves. One revolution of the cams gives two motions to the harnesses; what we take from one side or half of the revolution we must add to the other, if we start the sheds to open late, or after the crank has left the lower centre, with the lay coming toward the fell of the cloth; the shed will remain open longer with the shuttle in the opposite box, and very often pulls so hard upon the weft that when the sheds cross the coarse yarn of the selvedges will cause it to break and make what is known in weaving as "rat holes." If we start the sheds to open before the cram reaches the bottom centre the harnesses will close upon the shuttle causing breakage of yarns and poor, rough selvedges.

The proper position of the lay when the sheds start opening is the bottom centre. If we want tightly woven selvedges delay the cam just a little, but not enough to cause the errors above referred to. If loose selvedges are required, push the lay a little back of the centre and start the cam. I now refer to looms running with the crank toward the fell of the cloth. The opposite would be the rule upon English looms that revolve away from the fell. To attain cover upon plain cotton cloth and to assist in beating the picks into place, attention should be given to the height of the whiproll and breast beam with relation to the shuttle race. The warp yarn should be dished one-half the sweep of the lay to get the best results.

Where the warp yarn cannot be conveniently dished, as good results can be accomplished by having the whiproll carried back from the harnesses 24 to 26 inches on a sweep of 4½ inches.

The yarn in this case will be proportionately slackened and its elasticity given play, which will save many breakages. Most of our loom builders arrange their looms so that the whiproll is stationary, but this should not be the case; an opportunity should be given the weaver to change the distance according to the class of goods to be woven. Provision should be made for this in the construction of the loom. Stiffness in a whiproll is quite necessary; if it yields to the beat of the lay, the line of the weft will show itself in the goods, causing bagginess in the centre that cannot be taken out in finishing. The size of the harness cam should be regulated to the sweep of the lay. On a 40-inch loom with a sweep of 4½ inches, the shed should not open more than 2¾ inches at widest point. The cam controlling the harness furthest away from the fell of the cloth should be at least ⅜ of an inch larger in diameter. This prevents the shed from falling upon the shuttle on account of its greater distance from the fell.

The treddles connecting the harnesses with the cams should have revolving trucks chilled to prevent wear and to give a smooth, easy motion. Each treddle should be constructed to give the full throw of its cam with an easy strap having sufficient length from the trucks to the end, so that the harnesses may be drawn forward slightly at the bottom to assist shedding without pulling too tight upon the straps. Length of treddle from the trucks to the fulcrum should be considered so that we can get a slow, easy movement of the treddle without carrying the harnesses through too much space, but with curvature enough to keep the truck in connection with the cam during the whole revolution.

The oscillating shaft above the harnesses, upon which are placed the balls to which the harness straps are attached, should be of such size that one-half the revolution will take up all movement of each shade of harness, the larger ball for the largest cam.

Harness straps should be of even thickness and shaved so

that they will be supple and easy to roll upon the ball when the opposite harness pulls.

Cotton goods of all classes are made upon certain lines for weight and width with a number of weft and warp threads to an inch of woven cloth. To do this accurately some sort of taking-down and letting-off motion that will operate with precision should be furnished with each loom. There are a great many devices made upon the above lines and they accomplish with more or less uncertainty the duty of letting off the warp and taking down the woven cloth.

While it has been easy to make a taking-down motion for the cloth, it has not been so easy to make a letting-off motion for the warp that we can rely upon to work in connection with the taking-down motion and give with accuracy the desired number of weft threads in the high picked goods of medium numbers. You may have a letting-off motion that will not let off while the pick is being put into place. Another that will let off when the sheds are crossing by the vibration of the whiproll. Another that lets off by the swing of the lay as in the Bartlett. You may also combine all these with a friction arrangement as in the Lowell loom, but I have yet to see one of them that will give accurate counts at all stages of the running out of the warp beam, from full to empty. English loom builders adhere strictly to absolute friction and I am inclined to agree with them. Friction certainly has a wider range than any other letting-off motion that has yet been presented to our attention. This matter has been given a good deal of thought in England, and some excellent devices have been invented to meet the requirements of weavers.

One of the best of which I am acquainted with is called the "Woodhouse Friction Disc," and is furnished by David Sowden & Sons, of Shiply, Yorkshire, England.

In the higher picked heavy goods one fact seems to be overlooked by our loom builders when considering the letting-off motion, that is, the "elasticity of the yarns." A proper let-off motion has this fact to deal with, and until some device is in-

vented that will overcome or control the elasticity in the yarns of the warp we will not get even count goods.

An ideal letting-off motion will be found in a proper friction disc, the leverage weigh to fwhich is controlled by an arrangement for sliding the weights as the warp is reduced in size and weight. A vibrating whiproll can be used to take the shock or blow of the lay from the friction disc while the pick is beaten up to place, making the taking-down motion a steady pull upon the friction. The continuous changing of condition makes an automatic letting-off motion defective when no provision is made for differentiation of both speed and weight of beam, the two great factors in weaving. The letting-off motion has a great many times to face the problems of impractical weaves, such for instance, as trying to crowd into a square inch yarns that will measure 1¼ square inches. I have in mind two well known cloths that have a high reputation in our markets, that are constructed of such yarns as I mention, but after the best efforts of both loom and weaver have been expended upon them they are not what they claim to be in counts. If a little more attention was given to the diameter of yarns we should not be called upon to weave goods where picks cannot possibly be beaten in. Nothing will control such weaves as I mention or give anything nearly as correct as friction. The yarns are stretched to their utmost and friction is the only practical motion that can take the elasticity of the yarns into account. Weavers are not slow to take advantage of the stretching of yarns and to pull forward the cloth roll, thus making the goods lighter in that particular spot.

To prevent a weaver from pulling the cloth roll forward and thus making goods full of thin places, a device has been invented by WILLIAM LIVESY, of Blackburn, England, consisting of a locked pawl that is only released by the swing of the lay and operates in connection with the taking-down ratchet. The cloth or sand roller of the loom that pulls forward the warp as the cloth is being woven, should be protected by binder rolls, and the gearing of taking-down motion should be compounded so

that the strain of opening the sheds and beating up the picks will not stretch by back lash the woven cloth. The pick should never be beaten up to place with the yarn unyielding.

The taking down should take place when the strain is even and full upon the yarn. Do not take down when the pick beats, but let off to prevent stretching. Take down when the sheds are starting to close before the yarn is too loose, so that the drag of the temples will not cause the selvedges to weave longer than the centre and so often compel the loomfixer to put on the sand roll an extra cover, thus making the evil worse so far as the looks of the cloth is concerned both in the grey and finished. Remember that in whatever direction the yarns may be strained while being made up into the fabric, the goods will show evidence of it wherever they may be used either before or after finishing.

LOOM-FIXER.

A good loom-fixer is an important hand in a weaving room. He should be a man of good clear judgment and of even temper, for he will have his trials with his weavers as well as the looms under his charge. He should have a practical knowledge of weaving and know the difference that a close heavy weave requires from his looms when changing from light to heavy cloths and vice versa.

He should likewise be a fair mechanic and know how the parts of a machine should be adjusted to run smoothly. Loom-fixing should not be done by rule of thumb, but rather upon certain lines of cause and effect. In a mill where goods are constantly changing from heavy to light and medium weights, he should adjust his loom to meet the conditions and not wait until the weaver calls him for a smash or broken part of a loom or picker stick. This is the evil of loom-fixing — "waiting for the weaver."

A heavy weave requires a more accurate throw of the shuttle, more power on the picking arrangement, the harness straps ad-

justed with more nicety, the letting off carefully tightened to resist the more frequent and harder beat of the lay. The binders in shuttle boxes and the temples should be looked over; more will be required from them. The heel strap on the Stearns motion, on account of extra power, will require tightening, and the lugs will undoubtedly have to be drawn forward slightly. In changing to light goods the loom should be eased in every direction that the weave will allow. A lower whiproll will be necessary, for yarn will not require to be loose and goods will weave evener if it is kept just a little higher than the shuttle race. This seems lots of work for the loom-fixer, but he will find it pays; he will get less calls from his weavers if he will take these things upon himself. He should never try to fix looms with an oil can. Looms should be regularly and systematically oiled so that all parts will run easy. A good loom-fixer will be interested enough in his work to occasionally study certain cloths he is weaving and see that the proper tension is kept upon the warps as they are reducing in size. Narrow and irregular width goods are made by neglect of tension. He will also see that worn out straps and cracked picker sticks are removed, as well as parts of the picking motion if they are much worn. He will likewise be slow to increase power upon his picking stick and rather seek for some other way of running his looms than by the forcing process. A good loom-fixer can be a very important factor in producing a superior quality of cloth from his section. He can also add to the product of such a section, but he must do it upon the lines I have mentioned. He must humor his looms, as it were, study each kind of goods he is making and give each the best chance it can get from the loom. Some men can, and all looms will do better if conditions are made favorable to their running at their best. A loom-fixer can likewise run his looms cheaper if he studies their needs; he will have less breakage of parts, his harnesses can be made to wear longer than if they were carelessly hung with either too tight or too loose straps. If light goods are strapped too tight on cams sheds will be larger than necessary and both yarn and harness

will suffer by friction. If heavy goods are strapped too tight the loom will labor too hard at the time when the power of the belt is required to throw the shuttle. The rule should be to strap the harness to the cams proportionate to the goods being woven. A loom-fixer should always use a washer under a nut when needed. He should not try to fix his looms with a hammer nor practice tightening small bolts with a ten-inch monkey-wrench. He should have a nice sense of the fitness of things. The binding of his shuttles for check in the shuttle box should be avoided. The heel spring and check strap should do considerable or nearly all of the checking, his shuttles will then come to rest without recoil.

Cop waste is a great loss to a mill, and a loom-fixer can prevent a great deal of it. One hundred Whitin, Colvin, Mason's, or Lowell looms can be run at regulation speed for supplies, including shuttles and harnesses, for about $400 per year, but they can be made to cost $600.

When sections cost more to run, as a rule there is less product and it is of an inferior quality. Sections should be run by the loom-fixers and not loom-fixers by the section. As manufacturers we should demand a higher order of loom-fixers, so that we could rate them as good mechanics. We can wear out our looms in a few years if we choose, but while it is being done we are getting a poor quality of goods and a gradually lowering product.

WEAVERS.

By weavers I do not mean those that oversee weaving, but those that actually do the work, that tie the broken threads and replenish the shuttle.

Invention has done much to improve our yarns and machinery, both in and out of the weaving room, and thus makes it much easier to master the "art of weaving" plain cotton goods, but we still require the services of the good, careful weaver, even in our mills making the lightest and cheapest goods.

Perfect weaving is scarcely thought of in the making of ordi-

nary goods, but what will pass in the market seems to be sufficient. This practice is likewise carried into the finer and more expensive goods, and percentage of product is now the greatest factor of modern weaving. Let me say here that our American goods have always been defective when compared with those made in foreign countries, and not always in the quality of the yarns used, but in the care taken by the weaver while goods were being made. It is a commendable idea to make our yarns so good that the weaver has only to tend an automatic machine, to "press the button" as it were, and the loom does the rest, but we must be careful and not carry this thing so far that our place in the markets of the world will be that of seconds in our own.

The broken warp threads require nicely mending, and the few picks of weft taking out or "unweaving" that have been placed into position before the loom could be stopped. The half or tangled pick of weft must be pulled straight or taken out when the shuttle is changed, and, the skill of the weaver known only to himself, must be used to prevent the mark from showing in the goods. There is great difference in goods of all classes, produced on the same looms, in the same room, and from the same yarns. Where does it come from? We must place the credit to the weaver. The higher the class of goods the greater will be the difference. Do not think I am arguing in this manner to discourage the use of the Northrop loom, for I am not. The Northrop loom has come to stay; it will find its place, and the idea of automatic weaving will be carried further than the most sanguine promoters of the above loom can now conceive, but I am sounding a note of warning in the direction of perfect woven goods, both from the loom itself, and by the care of the weaver. Our future vocation in New England as cotton manufacturers will be that of making high class goods, and we must look well to ourselves and see that we do not sacrifice quality for product and cheapness. The great diversity of goods that each mill is now called upon to make requires that we should have trained weavers that understand how to handle a great

many kinds of goods. Experience has taught me that to get the largest product of the best quality from my looms I must have a weaver upon them that is accustomed to that particular kind of work, and I could maintain a standard for a class of goods better by being slow to change a weaver's work and thus retain the benefit of his training. We may not wish, nor do we, to bind the weaver to his loom for years of apprenticeship, but we can and should appreciate faithful service, however so humble it may be.

Some mills discriminate against men weavers, preferring girls on certain kinds of goods. I do not think we get either more or better goods per loom on this account. Good, careful weavers are known by their work. Heavy work upon wide looms are mostly operated by men, the labor being unsuited to girls.

WEAVING ROOMS.

Good yarns properly prepared and put into looms suitable for the class of goods to be woven, and tended by weavers of experience, would be likely to furnish us with good cloths, but a weaving room built and furnished upon the best lines of modern practice is a most wonderful help in accomplishing the results above named. A weaving room should be built with due regard for light but not too much sun. It should have good, solid floors so that looms will stay where they are put. It should never be less than twelve feet in height nor very much higher. It should have natural means of ventilation. It should be built at least three times the length of its width and placed east and west where it is possible. Driving belts should be from below unless the room is a basement. Weaving sheds I am not in favor of; I think better results will be got from the lower floors of a mill.

In building weaving rooms from east to west, we to a certain extent and part of the year, avoid the direct rays of the sun. Practical weavers know that looms further away from sunlight give better running work. The north side of a mill is known as

the best place in the room to put heavy or fine work if on that side there are no obstructions to light. A good overseer will always put his hardest weaving on that side for reasons of moisture, "not being so dry on that side" and therefore weaves better. The driving belts in a weave room should be from below, their electrical influence is not good for the work and you will get more light with them out of the room and less oil from overhead shafting.

Some method of artificial moistening should be placed in every weaving room, of sufficient height above the looms so that it will condition the air rather than effect the warp at once. Sunlight must be overcome by artificial moisture; both its heat and electrical influences are injurious to the proper condition of the atmosphere to good weaving. We should endeavor to carry all the moisture that a temperature of 80 degrees will sustain, with a constant renewal of lighter atmosphere from above that will hold the lower air of the right weight to effect and mollify the warps. The moisture should not be such as to saturate the atmosphere at a low temperature, but steam should be used to prevent this and give the necessary heat to enable the room to carry sufficient moisture and the upper ventilation will prevent the temperature from rising too high.

Under the above arrangement a low studded room will soon either become too hot to get the benefits of the moisture or the atmosphere will become saturated at low temperature and hinder instead of helping the weaving. A very high studded room is harder to condition and is easier effected by outside weather than one of medium height, and while you must not strive to put heat and moisture enough into such a room as to cause saturation or "dew point," such a room can be held at a proper temperature and carry a large quantity of moisture. Fans for ventilation prevent the proper conditioning of the air and should be avoided as should all currents or draughts. Ventilation should be from above and enough of it allowed to keep the atmosphere in the room fresh and healthy. A weave room should have alleys or passages on the back of each line of looms

running lengthways of the mill for facility of changing warps and for carrying cloth and weft to and from the looms. The looms on each section should be numbered consecutively for convenience in keeping weavers' accounts and for facility in tracing imperfect work of looms or fixer. Section benches should be provided for each loom-fixer convenient to his section. Cloth racks should be near section benches, one for about 200 looms, so that order and neatness may be encouraged among the weavers.

A place should be provided in all weaving rooms convenient to all sides of it where imperfect goods can be overseen. For in this as in other things "eternal vigilance" is the price of good cloths.

The PRESIDENT. You have heard this valuable paper. In connection with it topical questions have been arranged, one as follows: number 79, "What is the best way to pay section hands in a weaving room where plain, twill, fancy, sateen, lappett and Jacquard looms are to be run?"

Mr. GEORGE OTIS DRAPER. Mr. President, in connection with Mr. HAWKESWORTH'S paper, I should like to ask him a little about that depression he recommends in the race-plate in the 40-inch loom. I have seen a great many American looms; we have had samples at our shops, and I have never noticed that any of them had a depressed race-plate. They are all level, so far as I have ever seen. I would like to know if this is one of Mr. HAWKESWORTH'S ideas, or whether he has found it on any special make of loom?

Mr. ALFRED HAWKESWORTH. In answer to Mr. DRAPER'S question, I will say that I have not found it but in English looms. I have made the depression myself a good many times in the Whitin and Colvin looms, for the purpose of throwing the shuttle correctly. My experience has taught me, and I know that it is so, that the shuttle has a tendency to rise on a level race, and I have found in practice that they will work better where the shuttle race is slightly depressed. The English looms have wide races; a narrow race is found in all American looms. Some of the modern English looms to-day are depressed half an inch, and I have a David Sowden loom, 90 inches reed space, where the race is depressed three-quarters of an inch. The width of the race is 5¾ inches in front of the reed.

Mr. GEORGE OTIS DRAPER. Mr. President, may I ask Mr. HAWKESWORTH one more question? Would he recommend any depression on a 28-inch print loom, and if so, how much?

Mr. ALFRED HAWKESWORTH. I would recommend a depression of ⅜ of an inch on print looms 30 inches reed space. I think at a high rate of speed you would have a much truer throw of shuttle from this centre depression. It assists in carrying the shuttle through very much better than with a straight and level race.

Mr. ARTHUR H. GULLIVER. Mr. President, I would like to ask Mr. HAWKESWORTH a question. Has he been able to get any shuttle maker to balance his shuttles when the patent spring with bolt and check nut is used? Has he been able to get a shuttle maker to give him a heavier tip at the other end so he can balance his shuttle? It is a point that has come up and I would like to know about it, for this reason, that we have found that with the new patent shuttles we get a great deal of trouble from having the shuttle too heavy at that end. One of my overseers of weaving has insisted several times that the new shuttles that were ordered should be ordered with a heavier tip, and I would like to know whether the thing is practical and whether the shuttle makers will do it or not.

Mr. ALFRED HAWKESWORTH. In answer to Mr. GULLIVER'S question I would say that David Dudley & Son of Wilkinsonville, Mass., have done it repeatedly for me and will do it for others.

Mr. FRANK P. BENNETT. In referring to weave rooms, I would like to ask Mr. HAWKESWORTH whether or not in modern mill construction, with large windows, he would recommend double windows for a weave room, to be put on in cold weather?

Mr. ALFRED HAWKESWORTH. In answer to that question, I would say, certainly. I have found in my experience that in winter time the cold will condense the moisture of the room, making it damper and heavier next to the windows. Therefore, I would want the outside atmosphere kept under control as much as possible, and depend upon the artificial atmosphere doing it evenly.

Mr. WILLIAM J. KENT. I have known Mr. HAWKESWORTH ever since I was a small boy and have always had a great deal of confidence in what he said; but on the 296th page of his paper is a paragraph which interests me very much, and which says, "Weaving sheds I am not in favor of; I think better results will be got from the lower floors of a mill." I want him to explain that, because it is contrary to all the education that I have had, and to-day the most modern mills that are being con-

structed have weave sheds. Now, if we are on the wrong track I want to know it before we build one.

Mr. ALFRED HAWKESWORTH. In answer to Mr. KENT'S question I will say that high-studded rooms, with overhead lights admitting sunlight from a tower or from deck windows, I have found to be very injurious to the proper condition of the atmosphere for good weaving upon fine and coarse goods mixed in the same room. It may be a matter of prejudice on my part, but my experience has taught me that I can get along better — I do not mean in a basement, I do not mean down in a cellar, but I mean on the lower floor of the mill, that is studded twelve or fourteen feet high, with a proper amount of light. I can condition the air better than I could in a very high room that is lighted from overhead, with the direct rays of the sun pouring in upon the warp yarns below it. The glass collects the rays of the sun and focuses them in such a manner that they are more intense than when coming from the side; it dries the atmosphere and whatever warp it strikes will be affected so as to weave very poorly.

Mr. WILLIAM J. KENT. Then I am to understand that the main point you have against the weave sheds is the height of the story, as it is generally constructed?

Mr. ALFRED HAWKESWORTH. Not generally the height, but the overhead sunlight and the effect it has upon the condition of the atmosphere.

Mr. WILLIAM J. KENT. Then will you please explain to me why the most modern weave shed on the other side of the water is constructed with four walls with not a window in them, not even a ventilator of any kind — just holes by which the water from the saw-tooth roof is allowed to pass out?

Mr. ALFRED HAWKESWORTH. I was given my first lessons in weaving when working in a mill in England, beginning as a boy of twelve and working there till I was sixteen or seventeen years of age. My first experience was in a weaving shed where there was not a side window, but the roofs, ten or twelve feet above the looms, were all glass, and the sunlight poured in upon

us, making it sometimes very uncomfortable. But remember, they have a different atmosphere over there. The atmosphere itself is suitable for weaving; you could almost weave out of doors when the wind did not blow. We do not get such an atmosphere over here. Our sun is too powerful, it has too much electrical influence, and the atmosphere is too dry. We require more moistening, and we cannot condition a high room as well as we can a low one. We have to use this artificial moisture to overcome the effects of sunlight.

Mr. WILLIAM J. KENT. Another question with reference to a statement on page 297: "We should endeavor to carry all the moisture that a temperature of 80 degrees will sustain." Now I would like to ask Mr. HAWKESWORTH, in a weave room on ordinary goods, or in a weave room where there are a great variety of goods manufactured, what percentage of moisture he considers the best?

Mr. ALFRED HAWKESWORTH. In reply to that question, Mr. President, I would say that I have prepared a paper upon the proper temperature and humidity of weaving rooms, which I shall read a little later. That will answer Mr. KENT'S question.

Mr. WILLIAM J. KENT. Yes, sir.

Mr. LOUIS SIMPSON. Mr. President, perhaps I might be able to give Mr. KENT some information in reference to the weaving shed question. I have had a good deal to do with weaving sheds in England, and I have made a study of the question. Mr. KENT must understand that the weaving sheds in England are generally built upon a clay soil which is very wet, and upon that soil they put a three or four inch flag. The weavers wear clogs in the old country. A clog is a shoe that is shod with wood, and consequently they are able to stand upon these flags without getting aches and pains in their limbs, whereas in this country, where weavers wear light, flimsy boots, if you asked them to stand upon such damp flags you would very soon have all your weavers sick and at home. Then, again, in England they try to build their sheds so that the glass in the roof shall face the

north; but even in such sheds they have had great difficulty in weaving during the spring of the year, when the dry east winds are prevalent, and consequently they have been accustomed to blow into their weaving sheds so much steam that the government has been called in to interfere, and now they have inspectors going around from mill to mill to see that the manufacturers do not blow into their sheds more than a certain quantity of moisture. They regulate the temperature as well as the moisture. I believe that with the ærophor system, or the drosophore system that is now in use on this side of the ocean, better results can be secured from rooms built after the system that Mr. HAWKESWORTH has mentioned, especially if you have double windows and especially, further, if you go to the expense of having the outside window frames calked.

I would like to say that in my opinion this paper of Mr. HAWKESWORTH'S is a very valuable one, and I make the suggestion to the directors of this Association that they have a large number of copies of it printed so that they might be distributed amongst our boss weavers and fixers. I think it is a most practical paper. I have read all the books upon weaving that have been published for the last forty years, and this paper contains more valuable information in a small space than anything that I have read before. But there are a few statements here which I do not quite agree with, and I would like to just mention them. On page 281 Mr. HAWKESWORTH says: "The heavy lay will be no disadvantage in weaving lighter fabrics, any more than slight increase in power." Now, in Lancashire they find that they do not get as good mull, which is a very light fabric, when woven upon a heavy lay loom, as they do upon a light loom. I just mention this so that Mr. HAWKESWORTH may reply. Perhaps in his experience he has found some way to obviate the difficulty.

Further, on page 283, Mr. HAWKESWORTH says: "The lay should be made from good, dry white ash." I have found in Canada that you cannot rely upon good, dry white ash, even

the very best that we can get, and I have found that it is far better to get the very best good, dry white pine.

On page 296 Mr. HAWKESWORTH says that the weaving room "should have natural means of ventilation." In preference I have always found it better to rely upon the ærophor or drosophore, and as far as possible to keep the outside air away.

Further, Mr. HAWKESWORTH says: "The driving belts in a weave room should be from below; their electrical influence is not good for the work, and you will get more light with them out of the room, and less oil from overhead shafting." If the weaving room is in a basement it would hardly be practicable to bring the driving belt from below. I have that part of the mill arranged upon the American system; I have another part of the mill arranged upon the English system. By the American system I mean where you have the back of the loom against the window. The English system is where the looms run from side to side, so the light gets the whole way down. In my experience I find that if you have proper hangers the English system is the best, for this reason: "the weaver, when piecing an end or drawing an end into the reed, does not stand in her own light at least half of the time, and consequently on our fine sleys and particular work I always arrange to put that cloth that I am weaving into the part of the mill which is arranged upon the English system.

Mr. HAWKESWORTH further says that he prefers to have the temperature of the room at 80 degrees. In Lancashire they try to keep it down to about 70, and I have heard many old weavers contend that it should be kept down to 65. That might do well in Lancashire, but I think here that 70 degrees you will find in most cases more suitable than 80. But I understand that Mr. HAWKESWORTH is going to discuss this question a little later, and I shall be much pleased to hear his views.

Mr. ALFRED HAWKESWORTH. In reply to Mr. LOUIS SIMPSON, I would say that the momentum acquired by a heavy lay will certainly strike a harder blow upon the warp yarn at the same running speed than a lighter one could, but if the resist-

ance was not there where would be the effect? If the mull weavers of Lancashire have a cam upon their looms that gives too rapid a movement of the harnesses and their friction motion is not under proper control, the least strike of a heavy lay will make a thin place; or should the warp be let back by any defect in either taking-down or letting-off motion, then I quite agree with him that a heavy lay would cause more of a defect. For such a light and special weave as "mull," I would not build a heavy lay, neither would I run very high speed, nor have a 4½-inch sweep; but I would create conditions to suit this special cloth.

In reply to Mr. SIMPSON'S further remarks, will say that in using either the ærophor or drosophore system in humidifying any room in a cotton mill, either he must rely upon "natural means of ventilation" or should he introduce fans, he will bring in more of the outside atmosphere that his system is trying to prevent or control.

What I mean by "natural means of ventilation" was neither to push nor draw the outside air into the room more than would necessarily come into it by natural means and from overhead as much as possible, to crowd the moisture-laden air down upon the work.

If Mr. SIMPSON will read the sentence (Page 296, "The driving belts in a weave room should be from below, their electrical influence is not good for the work and you will get more light with them out of the room and less oil from overhead shafting") in connection with the general sense of that part of the paper relating to weave rooms, he will at once see that my remarks were all in favor of the lower floors of a mill and not the basement. Looms in a basement have to be driven from overhead. I am still of the opinion that the American System of laying out a weave room with the back of the looms to the light is the best, for the weavers then in the middle of the rooms have not to take the shadows of every one nearer the windows, and there is a much better distribution of light.

The SECRETARY. Mr. President, relative to the suggestion of Mr. SIMPSON, as to printing extra copies of the paper, I will say that while the *Transactions* of this Association are copyrighted, the Board of Government permit any speaker to procure from the printer to the Association extra copies of their papers which are furnished at the cost of paper and presswork, with no expense for composition. That brings the cost of extra copies to a member very low. A notice to that effect is always sent out with the proof sheet from the printer, and the transaction is directly with him and not with the Association. Some members have ordered as many as 500 copies of a paper for their own distribution. The Board of Government of the Association have never authorized the printing of any portion of its *Transactions* for distribution, because it would entail a very large expense, and as a matter of policy they have always held that the Association should be administered entirely for its members, and have given such instructions to its Secretary.

Mr. GEORGE F. MORGAN. Mr. President, there are one or two questions I should like to ask Mr. HAWKESWORTH. He says that the length of stroke for a 40-inch loom should be 4½ inches. I would like to ask him if that short stroke would not require a much deeper cam to produce the required shed for the shuttle to pass through, and would not that require more strain on the yarn and cause, perhaps, greater breakage of the yarn than would be occasioned should we have a longer stroke and less depth of shed? You understand what I mean by that —that you have got to have depth of shed enough so that when the shuttle enters the selvedge it will not pass out or be interrupted but shall have free passage through the shed of the warp. Now if you block up that free passage by a short stroke on a 40-inch loom running 175 picks per minute, is not the liability of your shuttle flying out increased beyond what it would be if you had a longer stroke and not so much depth of shed, and would not it be easier on the yarn?

Mr. ALFRED HAWKESWORTH. In answer to that I would say that in doing so I cause less friction on the yarn. To cause

a longer stroke would oblige you to carry the harnesses back from the fell of the cloth. Therefore you would have to have a larger cam and the harnesses would have to pass through more space, and the tendency would be that the upper shed would hang upon the shuttle as it passed. I would overcome that tendency that there is to non-elasticity in weaving by carrying the whip roll farther back and leaving the harnesses as close to the lay as I possibly could run them. Therefore I do not approve of any longer stroke than 4½ inches, and I would shorten it if I could, but I think that is as short as you can run a 40-inch loom 175 picks per minute, viz., a 4½-inch stroke.

Mr. GEORGE F. MORGAN. Mr. President, there is another question that I would like to ask Mr. HAWKESWORTH as regards the swing of the lay. I understand that he says that the lay should be hung in the centre of its swing, or that the rocker shaft on which the sword rocks at the bottom should be at the centre of the swing of the lay; that is, it should go as far forward as it goes back from that centre.

Mr. ALFRED HAWKESWORTH. That is what I mean.

Mr. GEORGE F. MORGAN. Now, would not that materially effect the depth of the shed? If it only came up to a front centre there, and then rocked from the front centre back, would not you get a better dwell on your lay, allowing time for the shuttle to pass through, and at the same time bring your harnesses close up to that point, than you would if you went by that centre?

Another point in that connection, with reference to the temple. Now, if the temple is put on the breast beam and is brought as close to the lay as possible — which I have always intended to do in what little management I have had of a weaving room — so as to hold the selvedge down on either side, now when the lay rocks by the centre the shed of the warp cloth rises up nearer to the centre of the reed, and is not the stroke going to come a little harder on that, and is it not harder to drive up the pick especially on high pick goods, than it would if he had retained the shed down nearer to the lay still, and would not his

temple act better on the yarn? These are merely questions that I ask for discussion, to bring out points that, perhaps, I have not seen yet on the American loom.

Mr. ALFRED HAWKESWORTH. In answer to Mr. MORGAN'S question, I would say that I have found a great deal of trouble in the Whitin loom in the very direction of which he speaks. The Whitin loom is pivoted on the front of its swing. It brings the lay forward and puts the pick into place with the yarn resting upon the race. The temple is right down to the race, and very frequently will cut right through the iron shoe or cover of the race track. I have looms in my mill to-day that have very serious marks from the temple rubbing on top of the race.

Now, the other part of Mr. MORGAN'S question was, would not it be harder to pick up with the lay falling forward from the centre of its swing? I say no, it would be much easier, and it would be likely to spread the yarn upon the temple better than if it rested upon the race, for the revolving ball of the temple would take hold of the yarn much better when it was raised and clear from the race. If you will just think for a moment, when the lay comes forward the yarn spreads out to the width that it is drawn into the reed, and if it is clear it will spread easier. The revolving ball of the temple takes hold and spreads it out. If it is down below and resting upon the iron shoe of the race, as it is in the Whitin loom, it does not get as much chance to spread. I think, by all means, it is quite an advantage to have the lay hung in the centre of its swing.

Mr. GEORGE F. MORGAN. There are so many questions that are pertinent to this subject of weaving that I would not tire in asking questions all day and in trying to answer some myself if it was necessary, and there is one more that I have. Mr. HAWKESWORTH says, as regards the weight of the lay, that he can weave as successfully light fabric on a heavy lay as on a light one. Now, don't you find that it is more difficult to prevent thin strips with a heavy lay on light goods than it would be if you had a lighter lay, on account of the momentum attained in the process of weaving by swinging a lay 175 or 180

picks per minute? and many of them want to go up to 200 picks on a 36-inch loom. Is not the momentum attained with a heavy lay so much greater than it is with a light lay that it is very difficult to stop suddenly to prevent thin strips?

Mr. ALFRED HAWKESWORTH. To Mr. MORGAN'S last question I have to say that he is entirely mistaken; that the lay itself has nothing to do as a rule with the making of thin places. That comes from the letting-off motion and defective harness cams. The lay itself causes no thick and thin places. I take that very positive ground, that the lay itself makes no thin or thick places, but they come from defective harness cams and defective letting-off motions.

Mr. LOUIS SIMPSON. Mr. President, I have just thought of another point which is of interest in connection with Mr. KENT'S reference to the English weaving shed. One reason why in England they put up weaving sheds is owing to their insurance rates. You can insure a weaving shed in England for about one-quarter of one per cent., whereas they have to pay as high as one and one-half to two and two and a half per cent. for their spinning mills. So they put their weaving shed, as their climate is better than ours, outside of their spinning mill, to reduce the cost of their insurance. I thought that would interest Mr. KENT.

The PRESIDENT. The next topical question is No. 79, "What is the best way to pay section-hands in a weaving room where plain, twill, fancy, sateen, lappett and Jacquard looms are run?"

Mr. ALFRED HAWKESWORTH. If plain, twill, sateen, fancy, lappett and Jacquard looms are to be run indiscriminately and sections to be mixed, section-hands should be paid by the day. No other equitable way can be found without too much forcing. Sections should never be mixed, but divided into classes. Plain, twill and sateen can be run successfully on one section, fancies and lappetts on others. Jacquards should be run alone. In

this department in our mill every section-hand should be paid by the pick in his goods, together with the number of harnesses in patterns, the size of lappet frames and Jacquard machines and full play given to his individual skill by giving him full control of his weavers and his looms.

The management of our weaving rooms by overseer, second-hand and section-hands, to a great extent prevents our giving loom-fixers the important place in our weaving rooms they should occupy, and our methods are creating a low order of loom-fixing. Every department of labor in a cotton mill should be paid by piece work, where the labor can be computed, and there is no place of more importance than that of loom fixer or section-hand.

Upon plain, twill and sateen goods it is quite easy to see how a section-hand's wages can be computed, both for quantity and quality, and both should be the basis of compensation.

Careless and unskilful weavers are a source of loss to the section-hand and he should have some means at his disposal of remedying this, while he is held accountable for product. Upon fancies, lappetts and Jacquards a higher order of skill in section-hands is required, and there is more danger that poor weavers will hinder the best that a loom-fixer can accomplish. Quality in this kind of work means quantity, and the power of choosing his own help should be given him and likewise full control as to speed, etc., for running the different patterns that are given him to weave.

It is much easier to manage our weaving rooms upon the *day* principle and to pay section-hands, as most of us are now doing, by the day, but we have not been driven by competition in the fine points of manufacturing that our foreign cousins have, and we must look for a time when the firemen, engineers, mechanics, and every person not engaged in specific work for which a price is set, will be paid by the product of the looms.

Mr. GEORGE F. MORGAN. The limited time at my command to make answer to the above question, with a reasonable explanation for the same, together with a substantiating argument

defending it, is too brief to attempt anything but the most superficial presentation of facts which conduce to the answer which I shall briefly sum up and give.

The internal workings of the weaving department are to-day of more vital importance to the success of the mill (in the Northern States) than any other, and perhaps I might truthfully say in all the other departments taken together. Why? The answer is patent to all who have been more or less connected with cotton mills for the past two or three years.

In these days of sharp competition we very naturally turn to our weaving departments and investigate the methods employed to produce the greatest possible output, coupled with the highest grade of perfection obtainable under the conditions, and at the least possible expense.

How shall we best accomplish this is a question which involves all of the original or "topical" one, together with the broader, so to include the entire cost in the weaving department, which to my mind is so closely allied to the "topical question" as to make the two inseparable.

In a well organized weaving department of a cotton mill, we find an overseer, with such assistants (who are generally styled second-hands) as the character of the work may require, whose duties vary as the products of different mills vary, but who in a general way are to second the manifest efforts of the overseer to a successful operation of the department; and to see his orders are faithfully executed, to see that the section-hands promptly attend to the proper adjusting of the looms, in response to the call of the weavers, and also to see that the weavers promptly start on their looms at starting time (both morning and noon) and keep them running during mill hours. And thus in attending to such duties they are constantly moving about from point to point, never allowing themselves to be tied up at any particular place for any determinate period of time.

The section-hands whose duties, as the name implies, are assigned to the care of keeping in running order a section, or certain number of looms, which number varies according to the

style and character of the goods to be made. While the duties of section-hands are multitudinous in detail, and require their constant and watchful care, yet the more attentive a section-hand is to his duties, the less onerous is his task, and the more gratifying to the overseer and mill management is the result consequent to the faithful discharge of such duties when performed in a spirit of generous appreciation, that his employer is justly entitled to his best efforts in the exercise of brain and muscle; in return for which he receives a certain stipend, in amount depending somewhat on the style of the work, as well as on the quantity and quality.

Now, then, how can we best arrange for the payment of these duties of the section-hand (which the question at issue anticipates) so he may feel that his duties are duly appreciated, and that he, himself, contributes in no small degree to the successful operation of the department?

How best can this matter of wage be arranged so he may feel and know the better efforts put forth by him, resulting in a greater production, and approaching a nearer perfectness of work, will likewise receive its merited reward in the increase of wages? No, not increase, but *premium* or *bonus* given in excess of a stipulated price, as a reward for extra exertion in a greater production, and an increased percentage of excellence.

Then in formulating a method of payment of wages to section-hands, what are the factors to be considered? First, hours of labor; second, number of looms operated; third, production; fourth, quality. These are the factors, to a certain extent, manipulated by the section-hand. Or, in other words, these are his goods which he wishes to dispose of to his best advantage in the market of manufacture.

He holds the parity (not "16 to 1") of exchange of labor for money by the law of supply, and is ready to effect an exchange where he may receive in money a fair equivalent for the services he may perform.

Now, the manufacturer is about to effect a trade with Mr.

Section-hand. The manufacturer says to him, "We want the goods represented by you as labor; we want so many hours of labor per week, measured by the acknowledged standard of time that 60 minutes constitute an hour, and on this basis of time we will arrange the compensation, providing you can execute certain duties involved in keeping in good repair and working order a certain number of looms of a specified width, running a specified number of picks per minute on certain grades and styles of goods, which shall constitute a basis for a great variety of styles, picks, widths, etc., with a corresponding change of compensation suited to the changes in the character of the goods."

The compensation is now agreed on with the factors of hours of labor and number of looms only considered. Now, in taking up for consideration the factors of quantity and quality, we think it better to couple them together, and whatever compensation a section-hand may acquire from these two factors, it shall be in the manner of *premium* or *bonus*, as a reward for extra exertion and faithful performance of duty.

The agreement when completed would be something like this: For convenience we will assume this contract is made where standard sheetings are to be woven 36 inches wide, looms supposed to be only of sufficient width to produce such goods, to run 185 picks per minute with No. 22 warp, No. 26 filling, and to count 52x58. The section-hand to run 120 looms on the basis of 58 hours per week, and to receive $9.50 per week as stipulated compensation.

The manufacturer now says to him, "If from each of the 120 looms you are to operate you will deliver me six pieces of cloth, each piece 50 yards in length, with a percentage of imperfect not exceeding .03 per cent., as selected by an average of selectors in any half-dozen of reputable mills of New England, premium of a certain amount will be paid you in addition to the stipulated amount of compensation."

An agreement might also be made where the production and quality fails to reach the standard given above (which was only

done as a manner of illustration), and, in fact, make the compensation in part, dependent on the quantity and quality.

Mr. GEORGE E. SPOFFORD. Your committee on papers pertaining to mill work, having requested the writer to submit his views upon the "Best Way to Pay Section-hands in Weave Rooms," I beg to place before you for your consideration the few brief statements below, which, without any attempt at elaboration, embody the views of the writer upon the subject.

In a weaving room where the looms are on plain, twilled, or sateen goods, and no time is lost through shortage of either warp or filling, I consider it advisable to pay each section-hand according to the number of cuts produced upon his section. This method must increase his interest, if for no other reason than because it affects his pocket. An increase in the production from his section means a corresponding increase in his pay.

Men competent to successfully run sections, are, or should be, men of a certain degree of intelligence, sufficient at least to create in them a desire to do as well or better than their fellow workers, and when by so doing they can also increase the amount of their weekly wages, the inducement to do the best possible becomes a dual one.

Each section-hand is by this means interested in keeping the looms under his care in the best possible condition in order to increase his product; and he thereby becomes more interested in the details of his work, and approaches more nearly the plane of a successful second-hand or overseer.

It is sometimes said that this method has a tendency to increase the quantity at the expense of the quality of the work produced; but if the room is under the charge of a competent overseer, and the interest of the section-hands in their sections is by this method kept up to the proper mark, he will have more time to devote to the matters of second quality cloth, cost of production, waste, etc., all of which are important items in a weaving room, and demand the time and attention of every careful man.

Again, the conditions that insure large production, *i. e.*, looms in perfect running order and promptly and carefully fixed, also insure quality. How often do we see when the quantity goes up the second quality goes down, and *vice versa*, when the product falls the seconds rise.

Paying by this method also brings to the direct notice of the overseer each week when he makes up his pay-roll, the exact amount of cloth produced on each section; thus more easily locating for him the weak spots and enabling him to apply the remedy at once.

It may be argued that all these things may be accomplished with the system of "day pay"; but I think that a careful investigation of the matter will show that it cannot be accomplished so easily nor so well. Overseers, as do all individuals, vary in ability, and although the very smartest of them may perhaps attain as good results with one method as with the other, men of medium ability, and there are many such, will, in my opinion, obtain greater success by the use of the method here advocated.

The limited time at my disposal for the preparation of this paper, the many phases of the question and the many details of the subject when applied to the varied styles of weaving, do not permit me to present to you all the interesting facts pertaining to the matter which a careful examination discloses, and as the subject of fancy and Jacquard weaving as applied to the question under consideration, is a subject varied enough to require a separate treatment, I have made no attempt to discuss it at this time.

The PRESIDENT. The next topical question is number 80, "What is the best temperature and humidity in cotton mills where both fine and coarse goods are to be woven?"

Mr. ALFRED HAWKESWORTH. The best answer that can be given to the above question is that each weave room must be a law unto itself. The term "fine and coarse goods" is subject

to a great range of requirements. The hardest weaves and the weakest yarns should be considered in first preparing the warps for the looms, and then temperature and humidity to suit the sizing. Warp softeners are now of great utility in weaving all classes of goods, and in a great measure render a weaving room less dependent upon high temperatures and humidity.

For goods of similar character to the "Lonsdale" cambrics, 96x104, with 40s warp and 60s weft, woven in the same room with goods as heavy as the "Masonville" sheetings, 88x92, with 28s warp and 40s weft, the proper temperature should be from 76 to 80 degrees Fahrenheit, and the depression of the wet bulb on hygrodeik 6 to 8 degrees. This would give a relative humidity of 66 to 72 degrees. If the goods to be woven were more nearly alike and not so heavy picked, I would run the dry thermometer at 72 degrees and the wet bulb at 62 degrees. This would give a relative humidity of 57 degrees. Under high temperature the atmosphere is capable of carrying a great deal of moisture; it is likewise very elastic and presses with considerable force, and from the absorbent nature of cotton soon affects the warp yarns, softening and strengthening it and enabling the loom to beat up the picks on heavy weaves much easier than it possibly could do if woven in a dry atmosphere.

From a great many experiments, extending over a number of years, I have found that yarns are very much strengthened by moisture. They are made pliable and much more elastic with different degrees of temperature and moisture, and will be found relatively stronger with same warp sizing.

From experiments made during the last month I find that dry yarns broken in the spinning room average 26.49 breaks 69.25 pounds double roving; wet yarns from the same sizings, 82.50 pounds. This wet yarn was saturated with water and simply squeezed out by hand. Slashed yarn from same sizings 84 pounds.

Yarns taken from the looms in weaving room and broken in the same atmosphere, temperature 78 degrees Fahrenheit, wet bulb 70 degrees, relative humidity 87 degrees. Same yarns as

above break 87 pounds. Experiments in slasher and weave rooms were made by cutting the yarn 55 inches long and tying a full lea of 80 threads for the breaking machine. Some days I found that the breaking strength would differ under the same conditions, but always showed a greater strength than when broken in the slasher room.

A number of years ago I had the misfortune to be managing a large weaving room where all the warp yarns were made upon mules, and some of it was very uneven and generally weak. The weaves were quite heavy. For the purpose of strengthening the yarns we starched the warps very heavy, using the best potato starch and no softener but tallow. I ran this weave room for months together with a saturated atmosphere carrying the dry thermometer 80 degrees and higher, and the wet bulb but one degree lower, having a relative humidity of 96 per cent. or "dew point."

While running the weave room under above conditions I found that the picks beat up into the goods quite easy, and they would very frequently count more than the gearing on the cloth roll called for. Upon the looms nearest the windows the goods would weave narrow as well as heavy, but in every case they would be smooth and clothy, showing a favorable condition while being made.

I would not advise a weave room being run under the above conditions. We have learned of late years how to make yarns better than they were made at that time, and together with warp softeners can run our weaving now under more pleasant surroundings.

Mr. JOHN ECCLES. In making a large variety of fine cotton fabrics, such as lawns, mulls, etc., we find from experience that from 75 to 80 degrees for humidity and 75 to 80 degrees temperature are best. At these points the rooms show the least number of looms stopped for breakages in the yarn. It is a sure indication that the temperature and humidity are right to look down a row of looms and see them all running and the

weavers walking around watching the warps for knots and bunches.

If we can keep our rooms comfortable it makes the weavers good natured and they are more alert and on the outlook for the imperfections which are in the warps. With the utmost care and vigilence these imperfections occur in numbers large enough to give sufficient trouble to the weavers. With the temperature and humidity at the points stated, the number of breakages is reduced greatly in comparison to the number which occur if the points are greater or less.

When we have dry northwest winds the yarns snap frequently. It is almost impossible to get the humidity just right to overcome this. In the winter months, when the northeast winds come, accompanied by a little sunshine, the effect upon the yarn is the same. It is difficult to make an artificial atmosphere to meet these electrical elements which cause fine yarns to weave badly. There are no artificial moistures that equal the natural. I am glad to say that there are great improvements made toward this.

Mr. ROBERT BURGESS. I do not at present feel equal to the task of adding anything new to what has already been said on the subject of humidity in cotton mills. I think the paper on "Humidity in Cotton Spinning," by B. A. DOBSON, read at the meeting held Sept., 1894,* treats the subject in a very comprehensive manner. If to the table he gives, showing the degrees of temperature and per cent. of humidity for the best practical results in the spinning room you add 15 per cent. to the humidity the best practical results will be obtained in the weave room.

As to the way in which these conditions may be obtained, the paper referred to treats fully. Also the paper of OTTO HOFFMAN, April, 1895,† on "Humidifying and Ventilating Mills."

Mr. RUSSELL W. EATON. I would say, Mr. President, that

* *Transactions*, Volume 57, page 185.
† *Transactions*, Volume 58, page 256.

it is my experience and my belief that the statement Mr. HAWKESWORTH made here has a great deal to do with the different statements that are made by other gentlemen in regard to moisture: the different preparations that they use for sizing their yarn require the different moistures. My overseer told me last week that he made a mistake in his work during the previous week in letting his room get too moist; it was too moist for the warp yarn — what we used for a softener, having a tendency to absorb moisture.

The PRESIDENT. The next paper on our programme is "Power Required to Drive Gingham Looms," by Mr. GEORGE W. WEEKS of Clinton, Mass.

POWER TESTS ON GINGHAM LOOMS.

GEORGE W. WEEKS, Clinton, Mass.

Most of these tests were by the writer on single looms, at the Lancaster Mills, but in a great many instances all on one line of shafting were tested together, and in some cases a whole room was tested and the average obtained in that way. The Bigelow looms are used nowhere except in this mill, and consequently would not be of much interest to managers in general.

The Crompton looms are standard looms and such as are used by other parties and which are the only tests which can be compared with results elsewhere, and for that reason may be regarded as the more important part of the paper.

POWER REQUIRED TO DRIVE VARIOUS GINGHAM LOOMS.

Dec. 30, 1870, A. M. English loom built by Geo. Hodson.
Run about two weeks.
7 shuttles revolving box.
Speed, 142 picks picks per minute = .195 horse power.
Same loom. Running only 2 shuttles at 142 picks = .1866 horse power.

Dec. 30, 1870, P. M. E. H. Bigelow loom.
Run since 1844.
4 shuttle cast iron drop box.
Speed, 107 picks per minute = .1818 horse power.

Dec. 31, 1870, P. M. E. B. Bigelow loom, built by the Lancaster Mills.
Run since 1850.
4 shuttle malleable iron drop box.
Speed, 114 picks per minute = .1818 horse power.

Jan. 30, 1871, A. M. E. B. Bigelow loom, built by the Lancaster Mills.
Run since 1860.
4 shuttle malleable iron drop box friction pulley.
Speed, 118 picks per minute = .1472 horse power.

Jan. 3, 1871, P. M. E. B. Bigelow loom.
Run since 1844 (about).
3 shuttle cast iron drop box.
Speed, 110½ picks = .1197 horse power.

Jan. 30, 1871, P. M. E. B. Bigelow loom, bought of the Clinton Co.
2 shuttles. Collins' patent harness motion.
Cast iron drop box.
Speed, 112 picks = .1064 horse power.

Jan. 3, 1871, P. M. E. B. Bigelow loom.
2 shuttles.
Speed, 120 picks per minute = .1505 horse power.

Jan. 3, 1871, P. M. E. B. Bigelow loom, bought of the Clinton Co.
2 shuttles.
Speed, 107 picks per minute = .1053 horse power.

Jan. 6, 1871. E. B. Bigelow loom.
4 shuttles drop box with E. B. Bigelow new let-off.
Speed, 112 picks = .108 horse power.

Jan. 6, 1891. E. B. Bigelow loom.
4 shuttle. Called a Pony loom, the pitman being attached to the lay on level with the crank shaft.
Speed, 114 picks = .132 horse power.

April 1, 1891. Crompton loom.
4 shuttle drop box.
Speed, 159 pick per minute = .223 horse power.

Jan. 23, 1892. Crompton loom at No. 2 weaving mill.
2 shuttle drop box.
Speed, 180 picks per minute = .252 horse power.

Jan. 27, 1893. Crompton loom at No. 2 weaving mill.
2 shuttle drop box.
Speed, 172 picks per minute = .2442 horse power.

Mr. LOUIS SIMPSON. At the last meeting of the Association there were also records of some tests of looms, but I regret to say that the statement of these tests is so made that I could not just understand what was meant. I would also point out that the conditions under which the tests were taken are not as definite as they might be, so as to afford the information to the members that they would have done had the conditions been more explicitly given. I think that they have not given the make of the cloth, and I think everybody here knows that the power taken by a loom depends a good deal upon the number of picks that you put in to the quarter inch and the coarseness of the yarns used. It would be of great service and a thing that we really want to know, what horse power looms would take, under conditions precisely stated.

Mr. WM. G. NICHOLS. Mr. President, in regard to this paper by Mr. WEEKS, on looms and the power required to drive looms, there was, apparently, only one loom tested in these later tests, and it seems to me it would be interesting to know what method was used in ascertaining the power used to drive a loom. One loom is a very uneven thing to drive; the power taken varies greatly at the different parts of the stroke of the lay; and I wish that we might have a little more data as to the method used in making these tests to find the power required.

The PRESIDENT. I presume that the Secretary might secure the information from Mr. WEEKS. I think he will very gladly explain his methods of making tests and give some of the data to which Mr. SIMPSON has referred.

The SECRETARY. In that connection I will say that Mr. WEEKS called at the office of the Association and stated that he was about to go to Japan, but he expected to amplify this paper, especially relative to the methods of the work, and some comparative results. If that can be done it will be published with these tests, making them more extensive. If he has already taken his departure we must wait until his return by the time of the spring meeting.

The PRESIDENT. The next on the programme is "Practical Theory of Steam Making from Shovel to Stop Valve." And right here I would like to apologize for the Board of Government for not having had this paper produced at the very first, for it seems to me that if we had all been posted how to make steam we could have kept these rooms a little warmer. I will call on Mr. WINTHROP THAYER of Boston.

PRACTICAL THEORY ON STEAM MAKING FROM SHOVEL TO STOP VALVE.

WINTHROP THAYER, Boston, Mass.

The theoretically perfect method for utilizing the caloric in fuel for steam purposes consists of *two parts: first*, to make a perfect combustion of all the combustible in the fuel, allowing no smoke nor gases to escape unburnt, or in other words, *perfect furnace conditions; second*, to *then use all* of this developed heat by its application and transfer to a body of water. How these results are nearest obtained practically, is the objective point of this paper.

Let us start with the fuel on the shovel, and we first find that all fuel requires application of heat to be ignited. That simple statement is of great importance to our furnace, demonstrating, under proper conditions, that the ignition of the fuel is quicker when the heat applied to it is more intense; its quickness of combustion depending on the amount of heat applied to it. Consequently, carrying this reasoning to extremes, we have under great heat, and proper conditions, a total ignition of all the combustible in the fuel, *theoretically*. Why not practically? Because, like the hustling dyspeptics, who cannot spare time for their stomach to properly digest their food, they in this case do not give the *furnace* time enough to digest *its* fuel.

In daily commercial practice we cannot do so, as the money invested in the plant demands that large amounts of fuel be burnt per square foot of grate. We can get air enough for combustion, too much, in fact, but we want *time* to properly mix the gases and air so that each atom of gas will find its atom

of oxygen under heat. We also want *time* to apply intense heat thoroughly. This period of time must then be allowed before the draft sweeps the gases away from the furnace, and it demands that this fuel must be surrounded and subjected to the most intense heat possible before leaving the furnace, or coming in contact with any cool surfaces of a boiler or furnace water leg. And as this desirable quick combustion cannot take place instantly, like burning gunpowder, and as good ordinary draft travels 30 feet per second, it demands that the furnace be a separate adjunct to the boiler, and of such length as will give time for the complete ignition and combustion of the fuel, before being swept away by the draft, to be chilled by the cool, absorbing surfaces of the boiler. Users of internally fired boilers recognize this fact and resort to the expedients of furnace fire brick arches and linings. The Pennsylvania Railroad use in their locomotive furnaces large fire brick slabs, all for the same reasons as previously stated. The Pennsylvania Railroad is a good criterion, as each locomotive is allowed a certain amount of coal for its specified run, and the engineer and fireman get a percentage of the saving from that allowance, which practice should undoubtedly secure practical economical results.

What would the furnaces in our houses amount to if they were not lined with fire brick tile? They would be like the old-fashioned country depot cast iron stove, the fire being blazing hot for a short while, and then quickly dying out along the outside edge, showing black by incomplete combustion, like cramps on a person taking a cold swim after a hearty meal. Same theory as in a furnace. Same practice to beware of.

Keep the furnace at an intense heat if you want to get good results, and keep it away from all cool surfaces until the combustion is completed.

The old-fashioned, well-posted engineers all knew and recognized it; expressing it in the statement that "the temperature of the waste gases entering the chimney must be from 550 to 600 degrees Fahrenheit, to get good results." *They were right, but were looking through the wrong end of the telescope* to get at

the object point, viz., *high furnace temperature*. Keep that as high as you can and it brings us to the second part of my subject, which is to have a so-called boiler of such capabilities that with this high furnace temperature we shall reduce the *flue* temperature of escaping gases to a minimum, and which is a long distance below that before mentioned 600 degrees; commercially, too, that is, when boiler is developing its rated power.

Before leaving the furnace subject, I would touch lightly on the loss by outside radiation from the furnace brickwork, as being a matter of little account; and if desired, this brickwork may be covered same as covering on the outside of internally fired boilers, steam pipes, or furnace water legs of boilers.

Having transformed the fuel to heat, we now take up Part II., which is to transfer that heat to a body of water by means of a boiler, so-called, in practice. The boiler has but the action of a sponge, to soak up and absorb the heat fed to it. It should swallow all the heat that the furnace has cooked for it at 2,500 degrees, and not allow over 425 degrees Fahrenheit to escape in the flue, when steaming at 100 pounds pressure. If this flue temperature is exceeded, something is wrong. It may be that the flames are smothered, as it is well known that a flame *will* be smothered after entering the length of eight inches into a three-inch tube, and may *re*-ignite in the flue, after leaving the boiler, where there is more area.

As the more perfect is the combustion, so is there a less amount of soot. We see that by troubles of our own in using oil lamps when the wicks get too high, etc.

Part I. theorizes on a practical furnace where combustion would prevent soot. Its advantages are readily apparent when the temperature in the flue of an average steam plant is noted at regular intervals after the boilers have been cleaned thoroughly. Use your thermometer or pyrometer and watch them carefully. They tell you what you are losing in gold dollar degrees of heat rolling up the chimney. *I would not have a steam plant without a temperature telltale in the flue, and have it where it can be readily seen and tabulated every half hour!* That

is the waste end that needs watching to pay dividends. Watch what a tale it tells after the boiler is cleaned, and you will see that the temperature of waste heat has dropped, but if you have a boiler that has horizontal surfaces to collect soot and ashes, so much the faster will you see the telltale thermometer in the flue rise steadily, showing how the accumulating soot and ashes allows the heat to pass off unabsorbed and wasted. I have seen this temperature rise 100 degrees in six hours from this cause. Give us, then, as near a *vertical* position as possible for the boiler heating surfaces, where the soot and ashes will *least lodge* and *accumulate*, and these surfaces should be so arranged as to be easily seen by means of peep holes or *easily* opened doors for casual inspection, *any moment*, by the chief engineer or superintendent, on their periodical walks each day.

As the *heat* side of the boiler surface is, so should the *water* side be, and the same conditions apply to both. As soot prevents the heat being used and absorbed, so does scale on the inside of the boiler act the same way, but in addition it endangers the life of the boiler.

Scale in the boiler is the *nightmare* to the owner, and a *mare's nest* to the coal dealer and the boiler repairer. Again, I *emphasise*, have your boiler heating surfaces so arranged that dirt and scale will the *least* lodge and accumulate thereon. *But* if the scale *does* form, have a boiler so built, that *all* scale, hard or soft, can be easy of access to remove, and the boiler be easily and readily seen for inspection in each and every detailed part. Also, if this scale cracks off, do not have such a boiler that this scale will accumulate on another place that is as bad, *or worse*, jumping from the frying pan into the fire. Any accumulation of this detached scale should be, with the dirt and mud, removed away from the action of the furnace heat. That theory is emphatically practical, *and in practice*.

If we lose sight of these important points, our subject, the boiler, this heat absorbing sponge, gets sick, its lungs clogged up, its work ceases, and an early grave and the torture of the blast furnace is its only reincarnation. Consistency is a jewel,

but deliberate repetition of a mistake, is an egotistical action of a narrow-minded intellect.

It was PATRICK HENRY who stated that "I have no means of judging the future but by the past." The past tells us that if we wish our steam-maker to last, and be a commercial success, we must *remove heavy joints, riveting*, and *bare tube ends* away from the direct action of the furnace fires. Thinness of metal is always desired, both for transferring furnace heat quickly to the water, and also as it lasts much longer than thick metal; on the same principle of the water absorbing the heat quickly from the thin metal, while the thick metal may get overheated and burn on the fire side, when the water side of the same plate will be all right; the lasting value of this thin surface being demonstrated by the old experiment of taking a dipper of water, and sticking a postage stamp on the outside bottom (care being taken to remove any grease therefrom) and then boiling the water in the dipper by placing it over a fire, and without scorching the stamp, showing how little wearing effect by heat there can possibly be on thin surfaces.

We none of us want our boiler pressure cut down just as we are congratulating ourselves on getting on a paying dividend basis, and thinking that we have a splendidly appointed plant; utilizing the economy of high pressure by harnessing it to splendid engines, and to find that the cutting down of the boiler pressure compels the abandonment of either engines or boilers, or else increasing the fuel bill 25 per cent. or more. There is no need of it, none at all!

There are boilers so designed that do not have that epidemic, and also combine the practical points referred to in this paper with the element of safety from explosions. No one but an eye witness can conjure up by wildest imagination, the frightful, agonizing horror of a steam boiler explosion, followed by its accompanying deadly-scalding vapor. There are many, oh, very many explodable boilers that do not explode. So are there many cans of dynamite that do not explode accidentally. The dynamite explosion is the more preferable of the two.

Yet, let us look at the annual reports of the boiler insurance companies, and scan the column of defects discovered, and *stop* when you reach the number of these defects shown to be *dangerous* — ONE IN EVERY TEN. Humanitarians and fathers of families will think twice.

In that lottery, *none* of us expect to draw that tenth number, yet the man is a *rarity* who does not occasionally like, and seek, to fool *himself* by trying to believe his own *wishes*, no matter what he *inwardly* believes.

Part I. having made proper combustion, and Part II. having used this heat as far as possible, we still have heat left, and want to use it all. Let us use it first *on* the steam, to secure its quality of dryness, that will give us the best efficiencies, also, if possible, to *superheat* the steam with this same waste heat. The obvious advantages of being able to carry steam long distances without condensation, *demands* that we should secure such superheat in our boiler. *See to what extremes and expense engine cylinders are jacketed to secure same results!* But care must be taken that the boiler superheating surfaces be so properly proportioned, that when the boiler is forced, the amount of superheating will be *less*. If otherwise, there will be deterioration or destruction of these boiler superheating surfaces.

Of course the waste heat in the flue must be as hot or hotter than the steam it has been superheating. To extract this heat by a so-called economizer, or system of water pipes, is most desirable, the amount of heat extracted depending on both the number of pipes and the amount of water passing through them. So this waste heat from our old friend, the furnace, is used to warm up the water for different purposes, such as fed to the boiler, or for use in the dye house or bleachery, or even for heating a mill, as is now being adopted in a large, progressive New England mill. Can we go any further? Yes, but depending upon how much heat our saving friend, Economizer, has not absorbed. By a further system of pipes in the flue a further absorption of the heat may be obtained. The pipes referred to are for air, and the air is for the supply under the grates, to

where this paper originally started, viz., the furnace. This system of supplying hot air to the ash pit, instead of cold air (which of course takes heat from the fire when passing through it) is not new, either as a theory or an experiment, but it is new in practice applied to coal firing, the first practice on a large scale being on the American steamship "New York," and the subsequent adoption on her sister ship.

The hot blast is in use in the iron and steel works, and is of almost universal use on the Cuba plantations where baggasse or wet, crushed sugar cane is used for fuel. Cold air blast necessitates the use of coal with it to handle the crop and the hot blast does not, the difference between the hot and cold blast being startling. While the cold blast showed a red or orange colored flame, the hot blast showed the dazzling white flame of perfected combustion, or high furnace temperature, as referred to in Part I.

This system of hot air applied under the grate of coal-fired furnaces should be as valuable as for the other mentioned purposes.

We have so far reduced the temperature in the chimney that we may lack sufficient draft, which *forces* us to what the writer believes to be almost invariably the best system of air supply to the furnace, viz., FORCED DRAFT, NOT *suction* or *induced* draft, the latter being only of valuable use where the flues and chimney are too small, and of poor arrangement, and where forced draft would be choked and a gas explosion in the furnace or flue liable to happen, and even here would I supplement the suction draft with the blower. Forced draft, *used correctly*, and with sufficiently large flues and chimney, will prove a money saver every time for the following reasons: It will allow the use of a cheap grade of coal, that packs down on the grate like sand, as the blower will force the air through it, and make combustion possible, and so prevent the roasted gases from passing off unconsumed. Some of those slack coals are very rich in carbon.

The blast box mouthpiece must be wide and large, so there will be no blow pipe effect on any single portion of the furnace.

The use of the blower has been abused by applying it to decrepit, overstrained plants, to force them to do more than they were able. My plan is to start out by using the blower system when everything else is favorable, and I have effected a saving in dollars and cents of over 20 per cent., month after month, by the use of this system, combined with the above-mentioned cheap fuel. The additional common-sense statements in favor of this blower system are simple: first, forced draft is counteracting any leakages of cold air through flaws in boiler setting that are usually sucking in air, cooling the boiler, causing a loss. Second, all the heating or absorbing surfaces are made efficient and brought into use. In explanation of this, I would illustrate the action of a soft string through a tube. If it is *pulled* through, it will take the shortest way, following the end of the string being pulled, just the same as natural or suction draft will draw the heat or gases. Now try to *push* this same string through the tube, and it will curl and gather till it fills the tube, just as a forced draft would force the heat and gases to fill and spread over the whole surface of the tube.

Taking a horizontal tubular boiler, as an additional illustration, we find by thermometer that the temperature in the upper tubes, under natural draft, is much hotter than the lower row, as the draft will draw the gases to the chimney through the upper tubes, or the shortest way, the same as drawing the string through the tube; and I have fastened a piece of ordinary paper in the front end of a tube in the lower row of the same boiler, and after two days' run found the paper intact and discolored, but not even charred, proving this theory by practice.

Now *push* or *force* the gases or heat, and you will find a startling difference, and that with properly checked damper all the absorbing or heating surfaces are permeated throughout in every part with this heat *forced* upon them, setting *all* the surfaces at work. The draft will also be regularly uniform and independent of atmospheric changes. Forced draft is also of advantage in an emergency, as in case of a fire, to secure steam quickly.

For these various reasons I would judgmatically use a forced

draft to perfect Part I., my furnace, and utilize all my heating surfaces of Part II., in boiler, economizer and air heater.

Much could well be added to this paper, as only the essential points of a model steam-making plant have been outlined, and the points advocated are from results obtained by personal research and practice of the writer.

The PRESIDENT. The next paper on the programme is by Mr. JOSEPH H. KENDRICK, of Providence, upon "The Heath Metallic Bale."

THE HEATH METALLIC BALE.

JOSEPH H. KENDRICK, Providence, R. I.

The progress the world has made, during the past century, in the arts, in science, and in almost every department of life and business, is apparent to every thinking mind. Vast improvements have been going on everywhere, new methods, new inventions and modern ideas have been introduced generally, and could the merchant of one hundred years ago step in on us now, he would be filled with perfect amazement to see the changes which have been wrought in so short a period. Thousands upon thousands of miles of railroad have been built, and the "iron horse" speeds its way into every nook and corner of our country, opening up trade and business relations to sixty million people. Electricity, that still unsolved mystery of the universe, has been harnessed and applied to countless uses. We have but to speak of the telegraph, the electric light, and the telephone, to remind us of the wonders which the application of this subtle element has worked in the progress of the world; and yet, is it not strange that while in so many departments these stupendous changes have been taking place, that in some other ways the world has seemed to come to a standstill, as it were, and no progress whatever has been noted? There are several things we might speak of, but the one which we have in mind, and which is the subject of this paper, is in reference to the method of baling cotton.

To-day cotton is put up in common bagging, just as it was a hundred years ago, and while the objections to that method have been manifold, still, until the present time, no one has had

the ingenuity to invent something that was infinitely superior to the old method, and which at the same time is practical and inexpensive.

The objections to the present method of baling cotton are as follows:

First. The impracticability of using the baling more than once.

Second. The great difficulty in marking the bale. We say, in this connection, that the value of cotton which goes astray from poor marking aggregates $2,000,000 per year.

Third. The present bale gives no protection from fire. It is interesting to note that the *Financial Chronicle*, under date of September 8, 1894, states that the loss by fire, for the 28 years ending August 31, 1864, was over $183,000,000.

Fourth. The waste which occurs from loss of cotton by the bagging being torn, and the cotton bulging out and becoming soiled.

Fifth. The undue amount of space which the present bale of cotton takes, owing to the fact that the bale is not strong enough to permit the cotton to be sufficiently compressed.

The above comprises the principal objections to the present method of baling cotton, and we wish to call your attention to a new method, which overcomes every objection above referred to, and which, we believe, will completely revolutionize the present method.

The accompanying photograph shows a patented steel covered bale of cotton, weighing 457 pounds, and measuring 12½ cubic feet. The present style of cotton bale measures 28 cubic feet, and weighs on the average 500 pounds.

This bale is not only fireproof, but weatherproof, and is so proportioned that over 100 bales can be put in an ordinary freight car, which now only carries 40 bales. The freight rate from Texas to New England points is $1.17 per 100 pounds, and at this rate of freight, for this bale, a car would net over $300 more money to the railroad, than by the present method.

To illustrate on shipboard: The steamer "Glenisle," the first

steamer to arrive at Manchester, England, through the canal, carried 4,930 bales of Texas cotton, averaging 500 pounds per bale. In the same space we could have packed over 10,000 bales, averaging 457 pounds, so that the owners of the steamer, at the regular rate of freight, would net over $7,600 more money for this freight than by the present method.

From this it can be readily seen that when it is known that so much more cotton can be shipped in the same space, over the present method, the railroad and steamship companies can and will take the cotton at $5.00 per ton less than present rates, and still get larger freight money than they do now.

From the manufacturers' standpoint, this bale commends itself from the outset, because in the first place he saves the customary five pounds per bale for shrinkage in transit, which he now has to allow, and which on the American consumption alone (3,000,000 bales) makes an item of over $1,500,000 at to-day's prices, for in addition to this, by the new method no trouble can possibly arise from loss of cotton from imperfect marking. The term "blind bales" is fully understood by every cotton buyer. The marks frequently become obliterated or torn off, and upon arrival at destination there is always great difficulty in determining to whom to deliver, and in this connection we may add that the loss of cotton from imperfect marking under the old method amounts to thousands of dollars annually.

Again, the manufacturer would be favored because his rates of insurance will be much lower on cotton shipped by this new method. It can be shown where the saving to the manufacturer, in this country alone, in freight, insurance, and waste, would amount to over $3,000,000 a year.

The insurance companies have been paying losses on an average for 28 years, $6,500,000 per year, and by our method their losses would be reduced to a minimum.

The South has plenty of iron mines and cheap coal, and to put up last year's crop, which was close to 10,000,000 bales, would have required over 160,000 tons of iron.

This bale can be made for less than the cost of the old style

of bagging and hoops; weighs 21 pounds, which is less than the weight of the bagging, hoops and ties, is made of interchangeable parts, and laced together with thin sheet iron strips, so simple in construction that a boy can put them together, and can be used over and over again until worthless for baling, after which it can be sold for sheet iron for roofing purposes.

The patents for this metallic covering have just been granted, and it only remains for the proper parties to become interested, so that the article can be placed upon the market. We are assured by some of the largest cotton men in the country that this is unquestionably the solution of the problem which has become more and more apparent during the last few years.

Such a bale as this has been demanded by the English spinner, and so serious has the matter become, that within a few months the Liverpool Cotton Exchange has passed a resolution that a discount of $25 per bale shall be made on all American cotton that comes in a mutilated condition, and when it is known that three-fourths of all our cotton goes to England and the Continent, one can see how important this matter is.

Comparison Between the Present Method of Handling Cotton and that Proposed by The American Cotton Bale Company.

Of necessity and owing to the extreme looseness in the handling of cotton in the old way, methods and charges vary greatly, so that any figures that are given as representing the expense, in any one section, are liable to alternate in minor details for different sections.

The figures given here are conservative, and represent the lowest average expenses under which the greater portion of the crop is handled. Indeed, the actual amount of these items is often in excess of that named, while on vast quantities of cotton there are added expenses of various sorts.

The figures given represent a materially less expense than the company will have to compete with in handling a very considerable portion of the crop.

The freight item is put at an approximate figure, the rates varying so greatly from different sections. It is immaterial, however, in the present case, as the same amount is figured on both sides. It is, however, very near the actual average.

The old method represents a multiplicity of handlers with no system of protection, while the new method means "from the planter to the mill with one handling."

Old Method.		*New Method.*	
For ginning, bagging and tie farmers pay per bale, av'age,	$3.00	Farmers sell direct cost gin and compress,	$ .75
Ginners' commission from old mill on seed $1.00 per ton,	.50	Covering steel,	.60
Loss from street buyers, sampling, etc., averaging 2 lbs. per bale at 6 cents,	.12	Expense of management, selling, sampling, etc., estim'ed,	1.00
Street buyers' commission,	.50	Insurance estimated,	.10
Weighing, 10 to 20 cents,	.10	Storage,	.15
Yardage,	.15	Freight. Call same as by old method,	4.50
Insurance 7 per cent. in yard, 15 to 50 cents,	.15	Brokerage in United States,	.50
Cartage to depot or compress,	.15	Marine insurance, 72 per cent. crop,	.15
Buyers' commission and expense 75 cents to $1.25,	.75	Total from field to mill,	7.75
Insurance at compress,	.10	Direct saving,	4.07
Sampling and marking at *do.*,	.10		$11.82
Compressing,	.50		
Freight, average to European mills $1.50 per 100 pounds. Average to American mills 90 cents per 100 pounds, 500 pounds per bale at 90 cents,	4.50		
Brokerage in America,	.50		
Marine insurance on export, 72 per cent. of crop,	.30		
Total from field to mill,	$11.82		

The American Cotton Bale Company propose to buy the cotton in the seed direct from the farmers, and consider $3.25 per bale a minimum profit for seed and linters. The transportation companies can carry in one car at half the present rates

of freight, and net about $90 a car more than they now get for hauling three cars. It may be reasonable to expect a reduction of 33 per cent., say $1.50.

The present export freight rate is based on 22½ pounds per cubic foot. Gulf ports steamers offer to rebate one cent per 100 pounds on density above 22½. The density of American Cotton Bale Company is 38 pounds and the rebate would be $0.67⅝; cotton received at mill, being better packed, no loss in weight, dry and in good order, a low estimate would be $1.25; a difference of $6.67⅝.

First. Cotton is preserved in dry condition and there is no loss in waste by cotton falling out of the bale as in old way of baling.

Second. Consumer gets full weight in cotton and there is less tare than in old way of baling.

Third. Cotton is delivered clean and on opening bale no strings or foreign substances, like bagging, pieces of hoop iron, or buckles, get into the cotton.

Fourth. The bale is opened much easier and quicker than the old bale.

Fifth. The bale is easily and plainly marked, thus preventing stray or blind bales.

Sixth. Twice as many bales can be placed in the same car, thus causing a less cost in transportation.

Seventh. The bale being entirely surrounded by the metallic covering, fire cannot be communicated to it from without, nor can one bale communicate fire to an adjoining bale.

Eighth. The cost of insurance would necessarily be less, both in transit and in storage, in consequence of the fireproof construction of the covering.

Ninth. Less space is required for storage both in the storehouse and mill.

Tenth. The customary allowance which the consumer gives of five pounds shortage in a bale is saved, because in this bale there is no loss in transportation or sampling.

Eleventh. The covering after use is much more valuable

than bagging and hoops, and may be used again many times over.

Twelfth. Cotton cannot become stained when packed in this bale, or get wet or dirty.

Thirteenth. The bale can be left outdoors without injury to the cotton by rain or other elements.

Fourteenth. The bales can be handled easier and occupy less space than if put up in cylindrical bales, this bale always keeping its square shape.

Fifteenth. The cotton baled in this manner is handled much less in compressing than in the old style of baling.

I wish to say that I have no interest in this matter, but simply present it to the Association on behalf of a friend who could not be here and who failed to get an expert in cotton buying and cotton baling to come, and, therefore, at his request I present it. Of course it is well known that it is an important matter; it is something which interests every manufacturer, this handling of cotton. We hope to have something here later on that will be of service to the manufacturer.

The PRESIDENT. You have heard Mr. KENDRICK'S interesting presentation of this new method of baling cotton. The next paper is "Power Transmission," by Mr. FRANK H. UNDERWOOD of Boston.

POWER TRANSMISSION.

FRANK H. UNDERWOOD, Boston, Mass.

To properly plan and equip a modern mill or manufacturing plant with its power transmission, and to observe the strictest economy in the cost of construction, operation and arrangement of space, has long been a problem difficult of solution, and while the writer does not deny that rapid strides have been taken in the proper direction, yet he does not believe that there is a mill or plant running in this country to-day that cannot be improved upon. In the early days of mill equipment we used square iron shafting, rounded at the point of bearing, joined with cast socket couplings pinned through the shaft, and having bearings of plain cast iron or wood lubricated with tallow. The pulleys were often made of boards nailed together to give sufficient width of face, trued up by saw or plane and occasionally covered with leather to give a good driving surface, and fastened to the shaft by small wooden wedges. The belting was generally constructed of strips of leather cut at random from the tanned hide and connected by thongs of raw-hide, or the lines were connected by plain cast gears. From this undeveloped stage of power transmission where an actual loss of from 30 to 50 per cent. of the indicated power developed occurred, down to the present time, the improvements have been marked. In order to properly convey my idea of what constitutes a modern up-to-date power transmission, it is my purpose to describe how I should arrange the transmission for a mill of, say, 40,000 spindles operated by steam power. Constructed of brick, with a steel framework, well lighted and heated, about 375 feet in

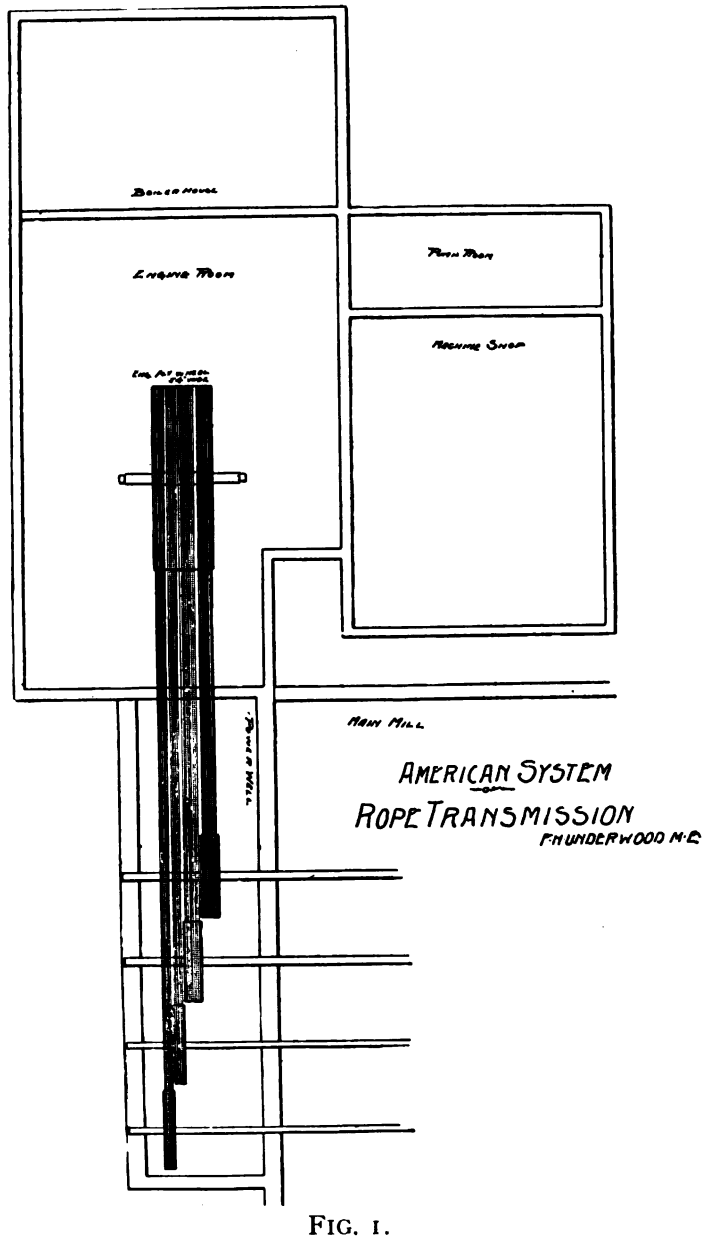
Engine Room
Main Mill
AMERICAN SYSTEM
ROPE TRANSMISSION
F.H. UNDERWOOD M.E.

FIG. 1.

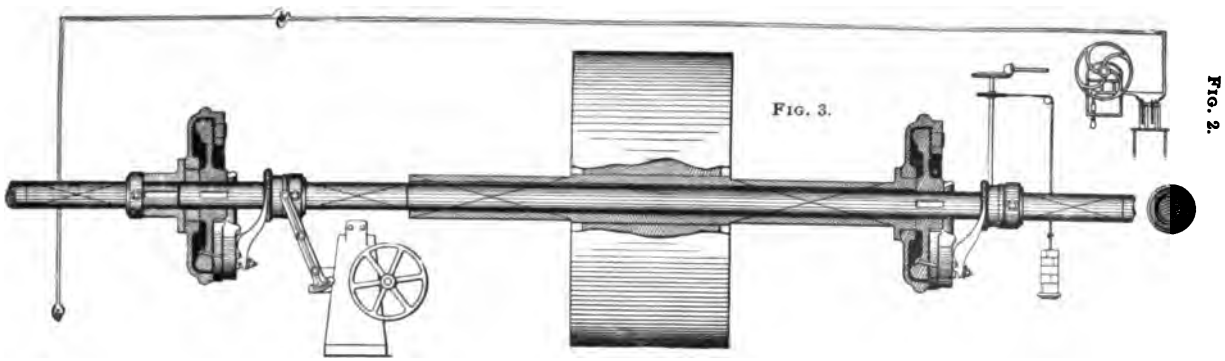

FIG. 3.

FIG. 2.

CUT OFF AND QUILL OUTFIT

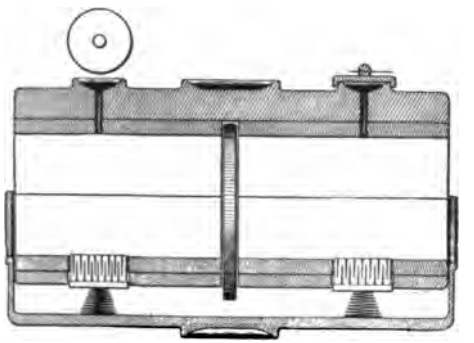

FIG. 5.

Capillary & Ring Oiling Box

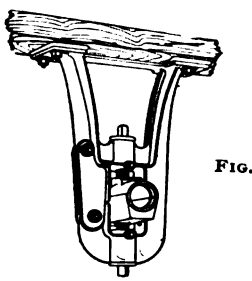

FIG. 4.

length, 90 feet wide, four stories in height, with a detached belt or rope tower at one end, also built of brick, with separate walls and no openings to the main mill, except where the shafting passes through, these openings protected with hinged iron doors on both sides of the wall. Back of the belt or rope tower should be located the engine room, and either to one side or back of the engine room, the boiler house. Connected to the engine or boiler house on one side a machine shop. The boilers and engines should be of modern type, selected for their efficiency and economy. On the crank shaft should be placed the fly wheel, made in sections bolted together, with a wooden rim to eliminate all shrinkage strains, and grooved with the requisite number of ropes for the different drives, in accordance with the improved American system. Each separate transmission should be provided with an automatic take-up (see Fig. 6), running on iron tracks, placed under the roof of the engine room, or in the rope tower. This would ensure a uniform strain upon each rope. The number of lines of shafting should be in accordance with the general arrangement of the machinery. For example, we will take four head or jack shafts in the tower; two on the first floor, one on the second, and one on the third; the power being taken from the third floor line, up through the floor direct to the machines in the fourth story. Iron girders or eye beams in the rope tower should be provided, to which should be bolted the pillow-blocks and base-plates, so made as to be adjustable in all directions, for the quills and shafts. These pillow-blocks should have combination ring and capillary oiling boxes, capillaries near each end, a ring in the middle. Split friction clutches, with electrical let-offs (see Fig. 2), should be provided for each quill, so arranged that in case of accident they could be controlled from any part of the mill or engine room.

On the quills (see Fig. 3) should be placed the driven pulleys, with iron hub and arms and wood rims, grooved and split. By using quills we would eliminate all strains on the jack shafts, each quill running in its own bearings independent of the shaft and doing away with the large diameter or bossed head lines.

Cross connecting transmissions may be introduced in the rope tower, so that in the event of an accident to any one transmission, the whole mill can still be operated. By using the American system nearly 25 per cent. of valuable space may be saved, and a quiet, smooth running plant obtained as a result. In the main mill the hangers (see Figs. 4 and 5) should be of a well braced, strong design, with open side to be closed with clamp link attachments, the bases machine-finished to insure a firm, full bearing of the hangers to girder clamps or girders, and to have ball and socket boxes babbitted and reamed out to standard size, with capillary oilers insuring a steady, free flow of oil, without sediment, to all parts of the journal. Wipers at the end of each box, or, better still, make the box so that the babbit at end of box will remove all oil and carry it back to bottom of box. Shafting should be of turned steel or iron, true to gauge, straight and highly polished. Flange couplings, male and female type, machine finished and with ample guard rim over nut and bolt heads. Bolts accurately fitted and couplings marked to place and faced off in lathe after keys are driven. Collars of a safety design with counter sunk set screws and lathe turned surfaces. Pulleys should be of as light construction as is consistent with safety, split in all cases so that couplings and shafting need not be disturbed, except in case of accident. Iron centre, hard wood rims to eliminate shrinkage strains or cracks, arms securely anchored to rims without bolts or screws, accurately finished both inside and outside and carefully balanced. Speed shifting mechanisms should be attached to all lines or machines, singly or in groups, where it is desired to change speed from time to time, thus avoiding the expense of extra pulleys and their changing. Clutch pulleys should be provided at all points where possible, and no shifting belts used. Belts of the best oak-tanned leather, with short laps, should be provided for all machine driving, but all cross connections from main lines to counter shafts should be made by ropes. In this connection I may say that the first cost of a modern mill, fitted up as described, would probably be more

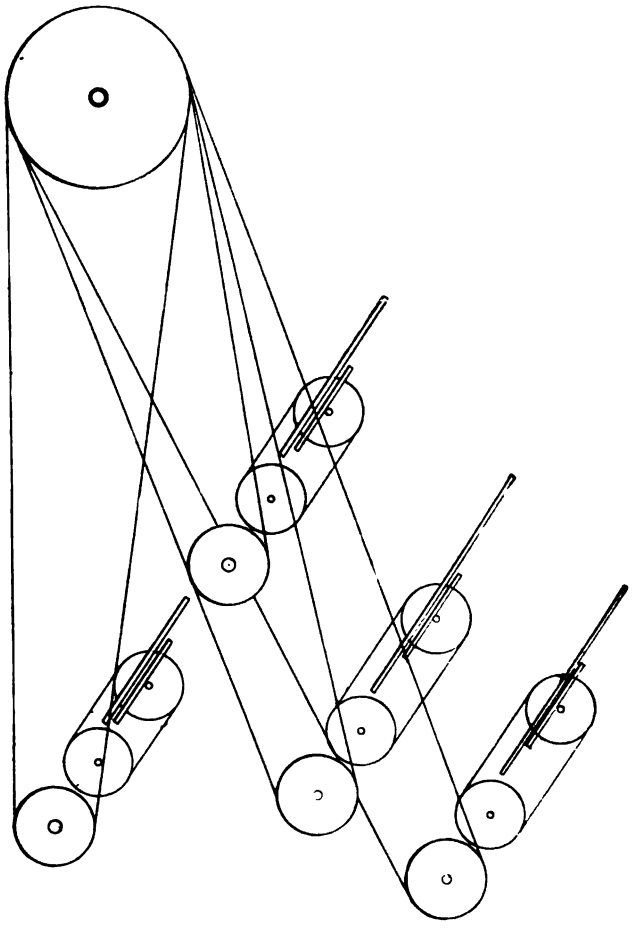

FIG. 6.

than if equipped in the ordinary way, but by comparing results obtained from such an up-to-date mill with those obtained by the ordinary mill construction, the amount gained in general efficiency and economy in running would startle one. In conclusion permit me to say that I think the time has arrived to carefully study, plan and arrange our modern manufacturing plants and to discard the heavy, cumbersome style of hangers, pillow blocks, couplings and iron pulleys, made to be sold by the pound, and that in their place we should erect as strong, graceful, carefully designed, and light power transmission machinery as is consistent with entire safety. In this manner we save a great amount of power and space that might better be employed in turning out an increased production of goods.

The PRESIDENT. The last paper on our list is one giving an account of an important economy in handling the raw cotton supplied to a mill and also of the moving of the finished product, and we will hear from ex-President EDWARD W. THOMAS.

ECONOMICAL ARRANGEMENTS FOR TRANSPORTATION OF COTTON FROM STOREHOUSE TO PICKERS, AND OF CLOTH FROM WEAVE ROOMS TO CLOTH HALL.

EDWARD W. THOMAS, Lowell, Mass.

In large manufacturing establishments, two of the chief factors of general expense to be considered are the economical handling of stock from storehouse to picker rooms, and the transportation of cloth from weave rooms to cloth hall, especially where the buildings are not in the immediate vicinity of each other.

The expense of these items, particularly where there are several mills and but one picker and cloth hall, amounts to quite a sum yearly. To best reduce this expense to the minimum is a matter of some consideration and study. I desire to give a very brief description of the methods employed in a manufacturing establishment with which I am connected.

The weekly production of this concern, at present, is about 400,000 pounds of finished product. There are ten mill buildings in which manufacturing is done, one of these containing practically all the picking machinery for the entire plant. The storehouse in which the cotton is unloaded from the cars is some 800 feet distant from the picker building. The method of transportation in use up to a recent period was to take the required quantity, or number of bales daily, from storehouse to picker by trucking, or by cars on railroad. As this meant the handling of between 900 and 950 bales per week, the expense was a large item, not only in labor, but in the expense of running teams, cars and elevators.

Some months ago the suggestion was made by one of our

employees that it would be a good idea to open the bales in the storehouse and blow, or draw the cotton through tubes to the picker by the use of fans, and save the handling above referred to. The suggestion was at once acted upon, and the following details will present clearly, I trust, the method adopted.

There was a small section in the cotton storehouse set apart, and thoroughly protected from fire by automatic sprinklers, pails, etc., of a capacity sufficient to hold two or three days' supply for picker. From this opening room two galvanized iron pipes, 18 inches in diameter each, having soldered joints, run underground to a mill some 50 feet away, through the basement of this mill, and the second story of an adjoining mill, thence across a public street to the picker building. Entering this latter building, the tubes turn at a right angle and run parallel with each other, and lengthwise the room, being hung to the ceiling and located immediately back of the opening machines, to which self-feeds are attached. In the tubes, in their passage through the latter building, are placed at convenient intervals dampers, so that the cotton may be dropped on the floor in various places required. About one-third the distance from the storehouse to picker building, and connected with the pipes, are two No. 8 Sturtevant fans, the method being employed of drawing the cotton for one-third the distance, and blowing it the balance of the way. Our experience is to the effect that the cotton is very thoroughly opened up by its passage through the fans, and is delivered on the floor of picker in a light, fluffy state. As an experiment we located in the pipes, just before reaching the dampers, about 20 feet in length of dust trunk, so that any sand or other foreign substance might have a chance to be removed by falling through. This scheme we find to be of material advantage.

From our experience we find the cotton better opened, or broken up, by handling in this way than where the cotton was put through so-called bale breakers. Three or four advantages may be mentioned as a result of using this system:

First. Less loose cotton is necessary in picker building, as

the fans may be speeded so that the actual amount of cotton on floor in picker may be graduated to, practically, a very limited amount, thus reducing risk of large loss in case fire occurs at that point.

Second. The cotton is in a much more loose state, and the self-feeds and opening machines are enabled to do more pounds each, and do it better than when fed direct from the bale.

Third. The advantage of a thorough mixing while in transit through the pipes.

Fourth. The saving of yard labor, and the fact that all handling is done indoors, and the saving of trucking in wet and stormy weather.

Not only can this system be used as described above, viz,, from storehouse to picker, but is being used in these same mills for blowing cotton from picker to dyehouse; from dyehouse back to picker, after stock has been dyed; and also from a waste-picking room up through five floors into a waste carding room.

We do not claim originality in the methods described above, only as a labor-saving device that might well be introduced in many mills where circumstances are such that the outlay for the plant would justify the saving in labor. We do take the position, however, that the cotton is in better shape to be worked than when fed direct from bale to self-feeds. It is immaterial whether the fans be located in storehouse or picker building, or at any intermediate point, and distance does not seem to play any important part.

Coming now to the other matter of handling cloth from weave rooms to cloth hall, or finishing room. There are at these mills over 4,000 looms, located in ten different rooms. By means of belts running over drums located in tunnels, all the cloth from these looms is conveyed to the finishing department, which is located in one building on the fourth floor. As the cloth is delivered by these belts in cloth room, it is "checked," and the weaver is credited with it; thus doing all the "checking" in one place, instead of in each weave room. Returns are made

weekly to the various overseers, in charge of the weave rooms, and pay-rolls are made up accordingly.

In these days of small margins and close competition, it is extremely necessary that attention be paid to many minor details of general expense that a few years since seemed trivial.

OBSERVATIONS ON THE AIR.

At the suggestion of the President, the Secretary states for the benefit of those interested in the subject, that members who desire to make observations upon the atmosphere and humidity of the air can obtain from WILLIS K. MOORE, Chief of the Weather Bureau, U. S. Dept. of Agriculture, Washington, D.C., a pamphlet of 100 pages, entitled "Instructions for Voluntary Observers," prepared under the direction of the Chief of the Weather Bureau.

This pamphlet also contains tables for the reduction of the observations on the wet bulb hygrometer, giving the dew point, relative humidity, correction to vapor pressure for reading of barometer, grains of water vapor in a cubic foot of air, table for reducing barometric observations to the sea level.

These are the tables used by the Weather Bureau of the United States, and will be sent to members of the Association on application. A catalogue of meterological instruments used by the Weather Bureau can be obtained from JULIUS FRIEZ, 108 East German St., Baltimore, Maryland.

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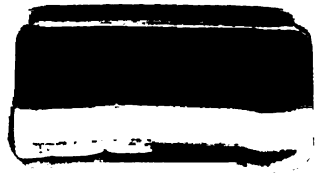
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